



# SCIENCE

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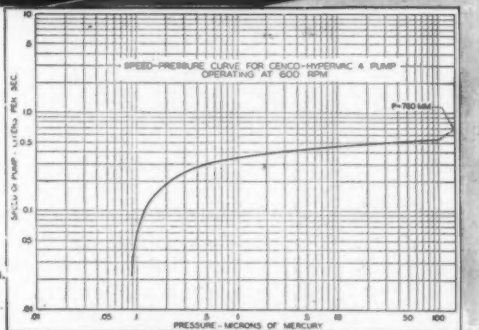
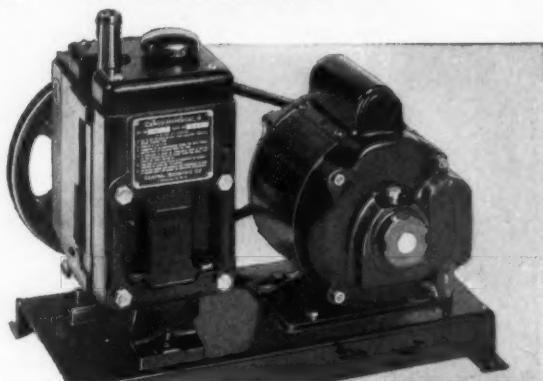
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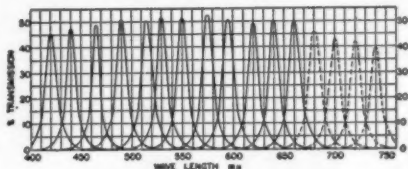
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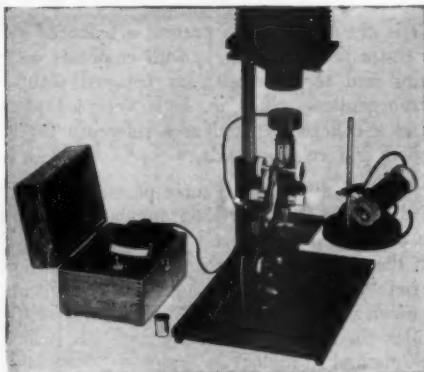
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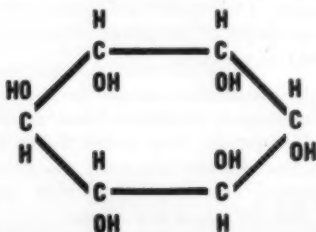
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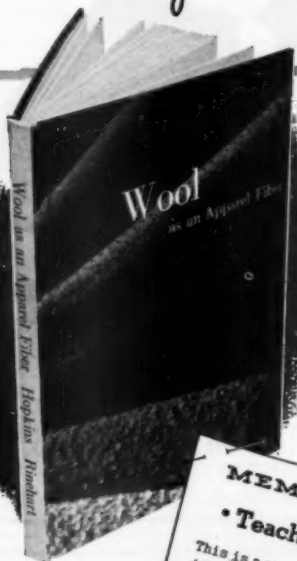
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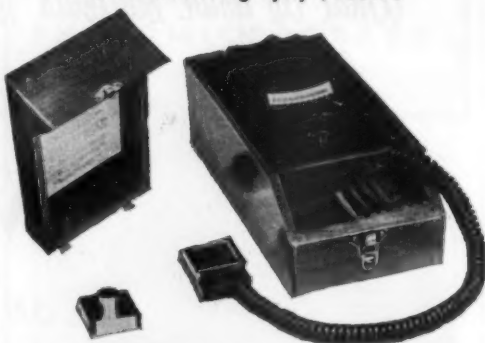
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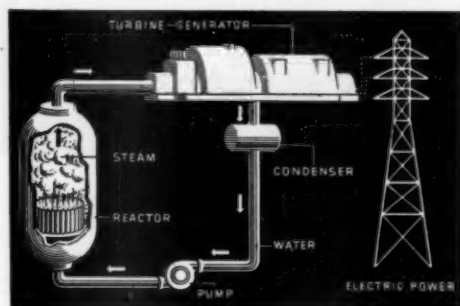
## F. K. McCUNE

*Mr. McCune is General Manager, Atomic Products Division*

"... We at General Electric believe that electric companies will be owning and operating a number of atomic power plants within the next ten years.

Second, we believe some of these will be full-scale and, what is most important, they will generate electricity at competitive costs, possibly within five, certainly within ten, years.

Third, we believe that this will be accomplished without Government subsidy for production plant construction or operation, and that Government-supplied fuel will be priced at cost-of-production levels.



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In saying these production plants will operate without Government subsidy, I do not wish to detract from the immeasurable significance of knowledge developed through A.E.C. contracts. Of course, the Government's large expenditures for research and development of plutonium production reactors, mobile power reactors, and other power reactors form the base from which private industry can proceed.

But, the important thing here is that we believe production size atomic power plants can be made economic. They will stand on their own feet. They may sell products to the Government. They will certainly buy nuclear fuel from the Government. But, trading with the Government need not be a subsidy."

*Atomic Industrial Forum Panel  
Washington, D. C.*

## K. R. GEISER

*Mr. Geiser is Supervisor of Engineering—Computer Unit, General Engineering Laboratory.*

"... There are three broad areas of manufacturing—manual, mechanization, and automation. In the manual area, physical effort is used to perform an operation by the use of hands or hand tools. In the mechanization area, manually operated power-driven machines, with varying degrees of controls, are used to perform one or more operations. Progressing into the automation area, we find automatic machines which are integrated with transfer devices to perform a series of continuous automatic operations. Here you see how industry can continually upgrade the manual operation into the mechanization area by replacing the hand tool with the machine; and then by adding transfer equipment we progress to the automation area. Please note that manpower will always be required. However, there will undoubtedly be fewer men as operations are automated and the emphasis will shift from the manual skills to the mental skills for both the productive and the maintenance worker.

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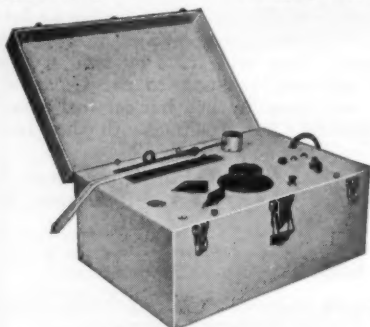
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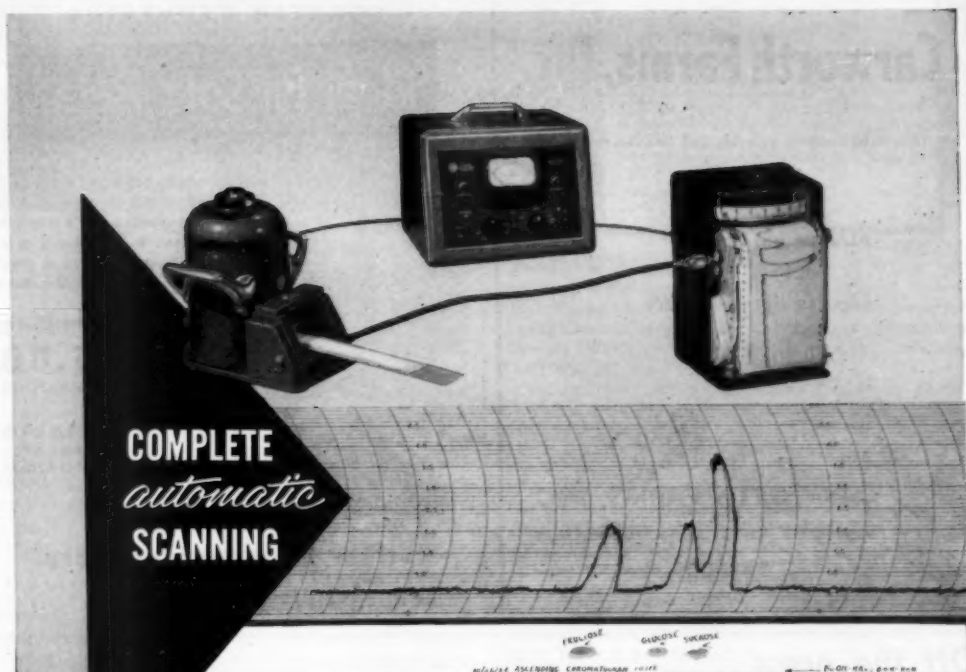
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## A Century of Entomology

ENTOMOLOGISTS in the United States are celebrating their first centennial year. This was established on the premise that a scientific pursuit emerges into a profession when someone is gainfully employed to devote his full time professionally to that branch of science. After surveying the early history of entomology in this century, the closest students of the subject agree that the inception of the profession here revolves around two official appointments. On 4 May 1854, Asa Fitch was appointed an official insect investigator for the state of New York. A few weeks later, on 14 June of the same year, Townend Glover was appointed by the Commissioner of Patents of the United States to collect statistics and other information on seeds, fruits, and insects in this country. Glover worked in a Division of Agriculture in the Patent Office.

Economic entomology in Europe antedated its establishment here by many years. According to L. O. Howard, however, insect-control measures suggested in practically all general books and papers on economic entomology in Europe prior to 1870 were ineffective and comparatively unimportant.

Before the turn of the century public attention was focused on entomologic problems because of the discovery of the gypsy moth in New England in 1889; the spectacular control of the cottony-cushion scale in California by *Vedalia*, a lady-bird beetle, imported from Australia also in 1889; the finding of the San Jose scale in the East in 1893; the spread of the boll weevil from Mexico to Texas in 1894; and the revolutionary discovery in 1898 by Ronald Ross in India that malaria is transmitted by mosquitoes.

A few of the major contributions of those working in the field of entomology in the past half-century are

Successful campaigns in the early 1900's to arouse the public to the menace of disease-carrying insects, particularly the common housefly.

Intensive antimosquito campaigns started about 1900.

Passage of the Plant Quarantine Act in 1912 to prevent entry of foreign plant pests and to prevent dissemination through the states of those accidentally imported.

Adaptation of airplanes for dusting agricultural crops, following World War I, and for spraying, following World War II.

Eradication of the Mediterranean fruitfly in Florida in 1929 and of *Parlatoria* date scale in California and Arizona by 1936.

Introduction of rotenone as a contact insecticide in 1930.

Invention in 1941 of the liquefied-gas-propelled method of dispersing an insecticidal aerosol, an invention that has developed within the last 9 years into a new \$250-million industry.

Rediscovery of DDT in 1942, its use in stopping a typhus epidemic in Naples in 1943, and its subsequent adaptation to a wide range of insect control.

Development by the booming insecticide industry, starting in 1946, of a wide range of chlorinated hydrocarbon and organic phosphate insecticides, each with specific effectiveness against certain injurious insects.

Adaptation of ground- and air-spray equipment for dispensing concentrated sprays as mists or fogs at small per-acre dosages.

Large-scale control campaigns against the pink bollworm of cotton in the Southwest, the oriental fruitfly in Hawaii, and the citrus blackfly and Mexican fruitfly in northern Mexico.

Observation in 1948 that DDT-resistant strains of houseflies were developing in nature and later observance of similar resistance in mosquitoes.

Use of radioactive tracers in insect investigation, starting in 1949.

Investigation, beginning in 1950, of the possible uses of systemic insecticides—those that are absorbed by the plant and translocated internally.

Synthesis of pyrethrum; development of allethrin and its commercial production in 1949.

From these rapid advances, many made in the past decade, it is safe to conclude that "the first 100 years of professional entomology were the hardest."

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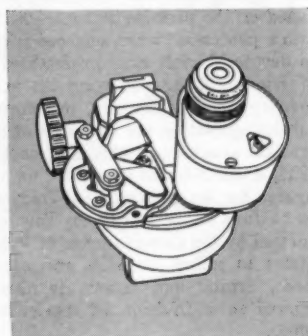


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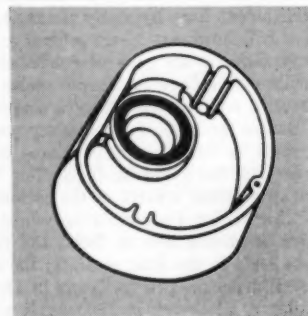
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# STEREOMICROSCOPES

# The Volunteer Subject in Research

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CLINICAL research frequently depends, for its existence, on the cooperation of volunteer subjects, paid or unpaid. Such volunteers are often utilized to provide data to serve as a "normal" baseline, or a standard of reference, against which data from "abnormal" subjects (for example, patients) may be measured. This article deals with certain aspects of a study (1) of drug responses in a specific "normal" volunteer population: (i) the psychological make-up of the volunteers, (ii) the reasons involved in volunteering, and (iii) the interaction between these first two factors and "primary" drug effects in determining the total drug responses. Finally, the problem of using the results obtained in such volunteer groups for generalizations to the population at large are discussed.

In the course of certain pharmacological studies on healthy young male volunteers, routine Rorschach tests and psychological interviews were obtained on 56 subjects. These young men were from 21 to 28 years of age and (with a few exceptions) were college students. All of them received one or more drugs as a part of experiments for which they received a fixed hourly stipend.

An examination of the Rorschach data and interview material revealed what seemed to be an unusually high incidence of severe psychological maladjustment (Table 1). The nosological classification is an arbitrary one, chosen to simplify the presentation of data. The "pigeonholing" of individuals into neat psychiatric categories is admittedly an oversimplification that is intended here only to indicate, in a rough way, the magnitude or nature of the psychological disturbance. There is little question that most of the subjects listed in Table 1 would qualify as deviant, regardless of the diagnostic label affixed to them by examining psychia-

trists or clinical psychologists. Of the three psychotics described, for example, two were hospitalized for psychiatric treatment either before or after the studies in our laboratory. One of the subjects listed as neurotic suffered from increasingly severe anxiety, for which he ultimately sought treatment in a psychiatric outpatient department. There the majority of staff members considered him to be schizophrenic. The incidence of homosexuality refers only to those volunteers freely describing overt and continuing homosexual activities and excludes any volunteers for whom evidence of homosexuality was only presumptive (for example, Rorschach responses or behavior under drugs). In all cases, both the Rorschach data and the interview material had to show significant deviation of personality structure and defense mechanisms from a broadly defined norm to warrant inclusion of a volunteer in the seriously maladjusted group.

The findings described thus raised the question of whether our "normal" sample was representative even of the special population subgroup from which it was drawn—that is, college students. Since our subjects differed from other students by reason of the very fact of volunteering for participation in experiments, it seemed reasonable to examine the literature for evidence of the importance of the "volunteer factor" in the accumulation of data.

Brower (2) studied the psychomotor performance of 59 volunteer psychology students and compared it with the performance of 149 students who were required to participate in the same experiments as part of their course. For five of the six measurements made, significant differences were demonstrated between these groups. Brower attributed these differences to variations in "incentive." Maslow (3) found considerable "volunteer-error" in a study of sexual habits of women. The volunteers in his study rated higher in both "self-esteem" and the incidence of "unconventional" sexual behavior than did his nonvolunteers. In another study, Maslow and Sakoda (4) studied the volunteer problem in conjunction with the acquisition of data from a college group by Kinsey and Pomeroy. Again, the volunteers rated higher in "self-esteem" than did the nonvolunteers.

Data from two college guidance clinics tend to confirm the suspicion that our volunteer group is indeed an abnormal sample in regard to personality problems. Fry (5) states that 16 to 20 percent of undergraduate students are seen in the guidance clinic at some time during their college career, usually with problems related to performance in the academic sphere. MeArthur (6) estimates that up to 20 percent of college

Table 1. Incidence of psychological maladjustment in 56 volunteers.

Psychosis	3
Psychoneurosis:	
Under treatment	1
Seeking treatment	6
Others	5
Psychopathic personality	3
Alcoholism	1
Overt homosexuality	6*
Peptic ulcer, severe	1
Stutter, severe	1

\* Two of these are also represented in psychotic group above.

students have serious adjustment problems, "usually neurotic but sometimes prepsychotic." In an essentially unselected sample of two college classes, Funkenstein and King (7) found that only 9 percent of 125 students were seriously maladjusted. Although it is difficult to be sure of the comparability of definitions of "serious maladjustment" when different observers are concerned, our group *seems* to show approximately an incidence of serious psychological difficulties that is twice as high as would be expected in an unselected college population.

An examination of the reasons for volunteering in our group is also of interest. A number of volunteers undertook to participate in experiments primarily for the monetary rewards. Many others, however, volunteered for other reasons. Some hoped to find professional advice and help or a drug that might prove "the golden key" to their personality problems. Some volunteered in a search for new experiences, much as a potential drug addict experiments with a variety of agents in a search for "thrills" or "kicks." Finally, there were certain volunteers whose primary reason for volunteering was a search for escape or release from personal problems and drives. This latter category included (among others) those who desired temporary relief from the boredom or pressure of everyday life, those who sought sexual gratification in a relatively guilt-free environment, and those who sought to satisfy self-destructive urges.

An interaction between "primary" drug effects and a psychological interpretation of, or reaction to, such effects, was reflected rather clearly in some of the subjective responses elicited from our volunteers. At times these "secondary" reactions were more marked than the "primary" drug effects. In these interactions, the basic personality of the subject and the reasons for volunteering seemed to modify the total response to a varying extent.

Certain subjects, for example, found that drug reactions which decreased reality contact were unpleasant. One subject described pentobarbital as unpleasant because "I was victimized by the drug. I dislike feeling sleepy when it's not produced by lack of sleep." Another subject found three different drugs (all of which produced a dulling of senses) extremely unpleasant because he feared that further dulling of his senses might occur without his knowledge or that he might not regain control of his senses. Both of these subjects had volunteered primarily for financial compensation, a fact that was not infrequently associated with a certain degree of apprehension and anxiety over the effects of the experiments.

The relationship of content of response to personality is demonstrated by the reaction of a homosexual volunteer to a dose of mescaline. Reduplication of visual images is a well-known occurrence after ingestion of this drug, but the fact that this subject described an infinite series of erect phalluses seems best interpreted as an idiosyncratic determination of content.

The presence of considerable chronic anxiety also

appeared to affect responses to drugs, by providing, as it were, a certain psychological "substrate." Thus one volunteer with severe anxiety neurosis had as a prominent part of his reaction to a series of sedative drugs the "release of tension." The three psychopathic personalities included in our volunteer group were characterized by a poverty of responses to a series of five drugs. Whether this was due to greater "inertia" of affect in these people, or to purposeful understatement of their reactions, or to other factors is impossible to say. Certain subjects who volunteered mainly in a search for new experiences described their reactions to placebos as "disappointing" or "depressing," since they looked forward to drug-induced mood changes.

It must be emphasized that most of the responses described were in no sense "placebo-reactions." Our volunteers were usually able to recognize an inactive medication on days when such was given.

What conclusions may be drawn from these data in regard to the use of volunteers? (i) Volunteers may differ quite markedly from nonvolunteers in a number of important respects. (ii) Regardless of whether *specific* volunteers can be categorized as "normal," the personality of such subjects or their reasons for volunteering, or both, may be important determinants of their responses in an experimental situation (8-10). (iii) Perhaps, especially in the area of subjective reactions, a careful eliciting of responses may permit the dissection of "primary" drug effects from "secondary" psychological reworking of such effects. (iv) Placebo controls, although important, are not adequate safeguards in this area. (v) Generalizations from data based on "volunteers" should be cautiously made. This is only an exaggeration of a general problem in investigation. For example, it is well-known that certain effects of morphine in a patient with severe pulmonary disease or of digitalis in a patient with congestive heart failure may differ strikingly from those seen in healthy male volunteers. Less well appreciated at times is the fact that even with two groups of healthy males, the incidence of certain "drug effects" may differ markedly. An interesting example is the fivefold increase in the gastrointestinal toxicity of quinaerine in Ohio State medical students when compared with Sing Sing prisoners (11). There is thus ample reason for wariness in making generalizations regarding drug effects from a study, no matter how careful, of any *single* group of individuals, be they sick or healthy, volunteer or nonvolunteer.

In view of the abundant evidence for the remarkable effects of feeling states on a large variety of physiological and psychological functions, and the nature of many volunteer groups (prisoners, conscientious objectors, students, and so forth), generalizations and predictions deserve to be exceptionally reserved when *volunteers* are the sole source of data. The recent excursion by Huxley (12) into the pharmacology of the subjective response is a reminder that much of the literature on marijuana, morphine, heroin, and similar drugs is derived from the experiences of "volunteers"



with unusual psychological orientation and imaginative, romantic proclivities. Without denying the "reality" of responses in such people, it has proved scientifically unwise to assume that such responses are typical of those experienced by all individuals under all circumstances.

That generalizations from volunteer groups are necessarily invalid, however, is a nihilistic and pessimistic view as untenable as claiming that volunteer data are infallibly transferable to all other situations. For example, the results obtained in a study of drug-induced mood changes in young healthy male volunteers in our laboratory were quite comparable with those obtained in a similar study in elderly patients hospitalized for chronic disease (13). In addition, distinct and reproducible patterns of response could be discerned in the volunteer group (14). This apparent predominance of drug effects, cutting across personality differences, suggests that the modifying effects of personality and motivation may be relatively minor at times or may affect details without obscuring larger patterns of response. How important the modifying nondrug factors are needs to be determined, if possible, in each specific situation. It is obvious that an awareness of the problems involved and care in eliciting and describing data will help in avoiding error and improving precision.

A final word should be said about the possibility of using to good purpose the very characteristics of certain volunteers that render them different from their

fellows. As previously pointed out, the total spectrum of a drug's effects is often apparent only when "abnormal," as well as "normal," states are studied. Purposeful focusing on subjects with "addict potential," or anxiety, or depression should render more easily detectable the effects of drugs on such parameters.

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## Toxicity of Cations toward Living Systems

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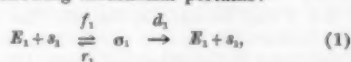
THE correlation of metal-ion toxicity with some physical or chemical property of the metals presents a challenging problem. Biologists, physiologists, and toxicologists have expressed widely divergent opinions (1, 2) concerning the possibility of such a correlation. Some have argued that the complexity of the living organism precludes any simple relationship. Others have pointed out that complexity has been encountered in other fields of science and explained.

In an important paper, A. P. Mathews (3), basing his arguments on data obtained for the eggs of the fish *Fundulus*, demonstrated a significant relationship between metal-ion toxicity and "electrolytic solution tension" (standard electrode potential). J. R. Erickson Jones subsequently made careful measurements with the planarian (4) *Polycelis nigra* and the stickleback (5) (a fish). He again observed a rough correlation with standard electrode potential. W. Seifriz (2)

presented an excellent discussion of the problem with particular reference to the slime mold.

The purpose of this investigation (6) is to describe a simple physiochemical model of the toxicological process and attempt to correlate the available data in terms of this model.

Consider an enzyme  $E_1$  at a total molar concentration  $e_1$  confined in a living cell. The enzyme finds itself in an environment containing its substrate  $s_1$  with which it reacts at a rate  $V_1^*$  to form a product  $s_2$ . Assuming that the enzyme obeys Michaelis-Menten kinetics, the following mechanism pertains:



where  $\sigma_1$  is the enzyme-substrate complex,  $f_1$  the rate-constant for the forward reaction,  $r_1$  the rate-constant for the reverse reaction, and  $d_1$  the rate-constant for the decomposition reaction.

By conventional mathematical treatment,

$$V_1^0 = \frac{d_1 c_1 s_1}{s_1 + K_m^1}, \quad K_m^1 = \frac{r_1 + d_1}{f_1} \quad (2)$$

If now an inhibitor  $I$  is injected into the cell at a concentration  $I$ , one may write for a competitive inhibition (7, 8):

$$E_1 + I \rightleftharpoons E_1 I, \quad K_i^1 = (E_1 I) / (E_1)(I), \quad (3)$$

and the reaction rate in the presence of the inhibitor  $V_1^i$  becomes

$$V_1^i = \frac{d_1 c_1 s_1}{s_1 + K_m^1 [1 + K_i^1(I)]} \quad (4)$$

It will prove convenient to define an inhibition index (7)  $\phi_1$  as follows:

$$\phi_1 = \frac{V_1^0}{V_1^i} - 1 = \frac{K_m^1 K_i^1(I)}{s_1 + K_m^1} \quad (5)$$

The relationship between  $\phi$  and the conventional percentage inhibition, percent, is given by

$$\text{percent}_i = \frac{100}{1 + 1/\phi}; \quad (6)$$

also

$$V_1^i = \frac{1}{1 + \phi_1} V_1^0 \quad (7)$$

$V_1^i$ , then, represents the rate at which  $s_2$  is produced in the presence of the inhibitor  $I$ . It will next be assumed that  $s_2$  is essential to the metabolism and life of the cell, and if it is not produced at an adequate rate the cell dies. That is, if

$$V_1^i \leq V_1^*, \quad (8)$$

death results. Here  $V_1^*$  is the rate of  $s_2$  production that is just inadequate to support life. Equation 8 constitutes a criterion for death.

In the absence of the inhibitor, the rate of the enzyme-catalyzed reactions is  $V_1^0$ . As the inhibitor concentration increases,  $\phi_1$  increases (Eq. 5). As  $\phi_1$  increases,  $V_1^i$  decreases (Eq. 7). Finally, enough inhibitor  $I^*$  may be added so that  $\phi_1 = \phi_1^*$ , which makes  $V_1^i = V_1^*$  (Eq. 8), and death results. Under these conditions, Eq. 5 can be rearranged to read (8):

$$pI^* = \left( p\phi_1^* + \log \frac{K_m^1}{s_1 + K_m^1} \right) + \log K_i^1. \quad (9)$$

Here  $p$  refers to the negative logarithm of the quantity involved. This equation may be rewritten, using new symbols, as

$$L = S + T; \quad (10)$$

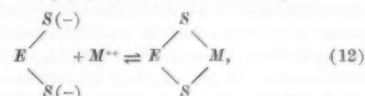
that is, the lethality  $L$  equals the sum of the susceptibility  $S$  (the term in parentheses in Eq. 9) and innate toxicity  $T$ . The justification for this interpretation of Eq. 9 may be made as follows. The susceptibility term involves the amount ( $p\phi_1^*$ ) that the key enzyme system must be inhibited for death. If  $s_2$  production must be closely regulated for the life of the cell, even a slight decrease in its rate of formation may be fatal (that is if  $\phi_1^*$  is small,  $p\phi_1^*$  is large and  $S$  is large). The second term in the parentheses in Eq. 9 shows

that the susceptibility depends on the concentration of  $s_1$ . If it is assumed that  $s_1$  depends on the nutritional state of the organism, one is forced to the conclusion that a well-fed organism is less susceptible to poison than a starved one. Thus the susceptibility  $S$  refers to the particular organism;  $T$  is simply the logarithm of the equilibrium constant for the inhibition reaction (Eq. 3). Since the loss in the free energy of inhibition is

$$-\Delta F_i = RT \ln K_i^1, \quad (11)$$

one may conclude that the innate toxicity  $T$  represents the thermodynamic affinity of the inhibitor for some key functional group in the enzyme's catalytically active site.

In applying the theory to cation toxicity, several additional assumptions (9) are needed: (i) In the cases presented here, metallic cations are toxic because they combine with a sulphhydryl group that is part of the key enzyme's catalytically active site. (ii) The driving force  $-\Delta F_i$  (8) behind this reaction,



is linearly related or proportional to the driving force  $-\Delta F_s$  behind the analogous reaction



where  $M^{++}$  represents the metal ion, and  $MS$  the corresponding metal sulfide. The more insoluble the sulfide,

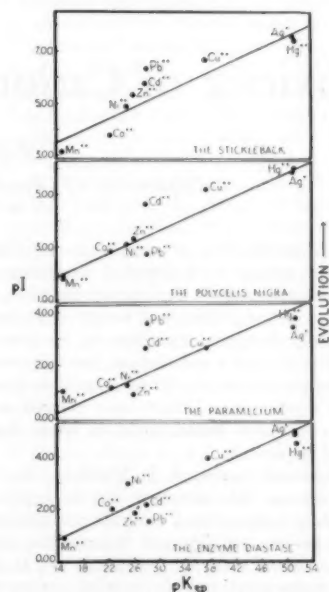


Fig. 1. Correlation of the toxicity ( $pI$ ) of metal ions toward various organisms with the insolubility of the corresponding sulfide ( $pK_{sp}$ ).

the farther reaction 13 proceeds to the right (and, by assumption ii, the same applies to reaction 12). The loss in free energy accompanying the formation of the insoluble sulfide is given by

$$-\Delta F_s = 2.303 RT pK_{sp}. \quad (14)$$

Here  $K_{sp}$  is the solubility product constant for the metal sulfide, and  $T$  is the absolute temperature. Then, according to assumption ii, and Eqs. 9, 10, 11, and 14, it follows that

$$T = \log K_i = (m) \times (pK_{sp}), \quad (15)$$

where  $m$  is a proportionality constant and  $T$  is the innate toxicity,

Equation 9 may then be written as

$$L = pI^* = S + (m) pK_{sp}. \quad (16)$$

This equation predicts that a plot of the negative logarithm of the metal-ion concentration just necessary to produce death against  $pK_{sp}$  will be linear. The theory also allows only one adjustable parameter ( $S$ ) per organism. Regardless of the organism studied, therefore, the innate toxicity of a particular ion will be the same; but the susceptibilities of the various organisms to poisoning by the ion will be expected to differ. Thus, a plot of  $pI^*$  versus  $pK_{sp}$  for the various organisms should result in a family of straight lines with the same slope  $m$  but with different intercepts.

Typical results obtained for the enzyme "diastase" (10), the paramecium (11), the planarian (4), and the stickleback (5), are presented in Fig. 1. The lines

have all been drawn with the same slope. Completely analogous results have been obtained for *Fundulus* eggs (3) and the enzyme urease (8).

A thorough statistical treatment of these and other data taken from the literature is being made and will be presented elsewhere. Numerous qualitative and semiquantitative observations have been and are being collected from a great variety of fields. The results obtained thus far seem to indicate a rather widespread applicability of the theoretical treatment.

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## Howard Bishop Lewis, Biochemist

THE death of Howard Bishop Lewis on 7 March 1954, following an illness of 14 months, brought to an end the illustrious career of a great biochemist, an ardent scholar in many fields, and a warm human being.

Dr. Lewis was born in Southington, Connecticut, on 8 November 1887, the son of Frederick A. and Charlotte R. (Parmelee) Lewis. At Yale, the award of the Chamberlain prize for the best entrance examination in Greek, followed by prizes in chemistry, the calculus, and Latin composition during his undergraduate years, gave early evidence of his brilliant mind.

After completing his doctoral work at Yale under the supervision of Lafayette B. Mendel, he served for 2 years as an instructor of physiological chemistry at the University of Pennsylvania (1913-15), and then joined the staff of the Chemistry Department at the University of Illinois, where he remained until 1922. At this time, because his inspirational leadership, sound research, and outstanding talent as a teacher had become nationally recognized, he was called to the University of Michigan as chairman of the Depart-

ment of Physiological Chemistry in the Medical School. He held this position until his death in 1954. In addition to his duties in the department, Dr. Lewis was also the director of the College of Pharmacy from 1933 to 1947.

The scope of his activities outside the university are too numerous to present in detail. Because of an unusual breadth of knowledge and skill of expression, his editorial work was most noteworthy. He has served on editorial boards of five national journals.

His broad interests in the fields of medicine and nutrition may be judged by his national committee assignments. From 1936 until his illness, he was a member of the council on foods and nutrition of the American Medical Association. In 1941-42, he served on the council of the American Institute of Nutrition, as vice president of the institute in 1941-42 and as its president in 1943-44. From 1945 to 1948 he was a member of the Division of Medical Sciences of the National Research Council, and from 1947 to 1952 he was chairman of the Michigan Nutrition Council. In December 1952, shortly before his illness, he served as

chairman of a symposium on nutrition held at the St. Louis meeting of the American Association for the Advancement of Science. In all these activities, to insure their success, he gave freely of his energy and enthusiasm.

A review of Dr. Lewis' contributions to medical education would not be complete without a reference to his long period of service (1935-50) on the National Board of Medical Examiners. I recall the long hours that Dr. Lewis gave to this arduous work at a time when he was already carrying a double load in the College of Pharmacy and the Medical School.

Over a period of years, however, none of his extra-curricular responsibilities were as important to him as those connected with the American Society of Biological Chemists. He served as its secretary in 1929-33, its vice president in 1933-35 and as its president in 1935-37, and he was a member of the council in 1937-40 and in 1941-42. Many biological chemists who hold responsible positions today remember gratefully the efforts made in their behalf when, for many years almost singlehandedly and with minimal secretarial service, Dr. Lewis operated the Federation Placement Service. His willingness to accept this heavy burden was motivated by his desire to know personally all his colleagues and to be in a position to assist them. Indeed, his warm regard for his fellowmen, his students, and his associates was one of his outstanding characteristics. It was a matter of great pride that for many years he knew by name not only all the members of our society but many members of our sister groups in the Federation of American Societies for Experimental Biology.

His research papers and review articles, numbering 177, indicate a wide range of interests. His first paper (1913) dealt with the metabolism of the hydantoins and his last paper (1953) dealt with the ergothioneine content of blood. His major research, however, was concerned with the metabolism of the amino acids and particularly with that of the sulfur-containing amino acids and related compounds. An invitation, in 1940, to give a Harvey lecture on "The significance of the sulfur-containing amino acids in metabolism" was in recognition of his international reputation in this field. Another group of papers by Dr. Lewis and his students is concerned with the detoxication of foreign compounds in the animal body. More recently, an extensive series of studies on the production of experimental lathyrism in the white rat have been made.

Although his tremendous energy was siphoned into many channels, Dr. Lewis held firmly to the belief that his main responsibility at the university was that of a teacher. Thousands of students at the undergraduate level, as well as at the graduate level, who listened to his lectures at the University of Michigan will testify that he never failed in this task. During a period of 30 years at Michigan, he was rated by the students as one of the most effective teachers of the medical faculty, not only because of the excellent organization

and presentation of his lectures, but because he had the gift of stimulating the interest of the students beyond that of the classroom requirements. He was continually in demand both on and off the campus as a speaker on scientific programs. He rarely refused these invitations, although his daily schedule of work was already overwhelming.

His appointment in 1947 to a distinguished professorship at the University of Michigan, designated as the John Jacob Abel Professorship in Biological Chemistry, was in recognition of his high scholastic standing. In 1949 he was elected to the National Academy of Sciences.

In 1915, Dr. Lewis married Mildred Lois Eaton. He is survived by her and two daughters, Charlotte and Elizabeth. Many of the social activities of the family revolved around their common love of music. The faculty and graduate students recall many pleasant evenings around their fireside. Dr. Lewis, no mean "chef," usually served one of his specialties at these intimate gatherings.

A hobby in which he had established himself as an authority was philately. Although in later years his crowded schedule did not permit him to attend the meetings of the stamp club or to participate in its programs, he nevertheless was an ardent collector until the time of his illness.

Dr. Lewis was born on a farm and throughout his busy career retained a love for the soil. To see him at his best was to watch him work in his garden, in which he took great pride. The appeal of the outdoors became greater in his later years, when his campus and national commitments became more and more pressing. He always looked forward with great anticipation to his short vacation periods, during which he and his family could tramp the mountain trails near their summer home in New Hampshire.

Those of us who were privileged to know and to be associated with Dr. Lewis held him in great esteem. We regarded him highly as an educator and investigator, and we respected and loved him as a colleague and friend. One of his outstanding characteristics was his ability to inspire his students to make the most of their talents. He frequently quoted from Pasteur, "Chance favors the mind that is prepared" to support the view that hard work and not luck is important in research work.

In completing this memorial to Dr. Lewis, nothing expresses our sentiments better than a line from a resolution read at the executive faculty meeting of the Medical School: "He taught the value of ideals and high standards of accomplishment, and gave to his pupils many guiding principles which have contributed to their enduring happiness and success in the profession of medicine and allied fields of science."

A. A. CHRISTMAN

*Department of Biological Chemistry,  
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## News and Notes

### The Thyroid

Under the general title, "The thyroid," the 7th annual symposium sponsored by the Biology Department of Brookhaven National Laboratory took place at the laboratory on 9-11 June. Ten papers dealt directly with the synthesis, distribution, and metabolism of the thyroid hormone. Four papers were concerned with experimental or spontaneous atypical or neoplastic growths in which the thyroid is involved.

The conference was opened with the introductory remarks of E. B. Astwood, who assessed the accomplishments and directions of recent research on the thyroid. In the first paper, Aubrey Gorbman described the evolutionary and embryonic development of the thyroid with emphasis on the synthesis of thyroxine and its precursors in certain invertebrates.

S. A. D'Angelo presented a study of pituitary control of thyroid function which included essential data from simultaneous measurements of thyrotrophic hormone levels in the pituitary and blood serum. The ability of thyroidal tissue to maintain large differences in iodide concentration from the body fluids and the factors modifying this ability were the subjects of W. P. Vanderlaan's presentation.

N. J. Nadler reported on collaborative work with C. P. Leblond in which the exact cellular site and the kinetics of thyroid hormone formation were investigated. It appeared from this paper and the discussion following it that the extracellular colloid may, in fact, be the place where thyroxine is synthesized. In concluding the discussion on thyroxinogenesis, Astwood analyzed the possible mechanism of action of those chemical substances that interfere with hormone production.

In the series of papers concerned with the distribution of thyroid hormone, S. B. Barker reviewed the chemical nature of the circulating hormone. Jack Gross reported on the relative concentrations and mobilities of thyroxine and tri-iodothyronine in various tissues. Alvin Taurog described work in which the excreted form of thyroxine was identified as a glucuronic acid conjugate.

The physiological effects of thyroid hormone on the cellular level were considered by Henry Lardy, who detailed the relationship of thyroid hormone to the cellular oxidative enzymes. The interrelationships of the function of the adrenal and thyroid glands were discussed by W. L. Money.

Hans G. Schlumberger reviewed the field of comparative thyroidal oncology and correlated atypical growth with geography and local conditions. H. P. Morris gave an extensive description of experimentally produced thyroidal cancers in which it was possible to relate different functional abilities with varying morphologic properties. The different patterns of radioiodine metabolism in various types of clinical and laboratory thyroid tumors were delineated by

P. J. Fitzgerald. A. Edelmann discussed the factors governing the genesis of pituitary tumors in mice after radiothyroidectomy.

No small degree of credit for the success of this symposium was due to the spirited and thoughtful discussion that followed each paper. In this connection the following moderators deserve mention: A. S. Gordon, E. D. Goldsmith, Aubrey Gorbman, Jack Godwin, and Jacob Furth. The papers and the discussions of them will be published by Brookhaven National Laboratory as No. 7 of the *Brookhaven Symposia in Biology*.

H. J. CURTIS

Brookhaven National Laboratory, Upton, New York

### The Teaching of Physics

The American Association of Physics Teachers met on 28-30 June at the University of Minnesota in Minneapolis in conjunction with the American Physical Society. Aside from a thunderstorm, the weather, though hot, was mostly clear. This cooperation of the weather was especially appreciated Wednesday morning at the time of the total eclipse of the sun.

Consideration of various teaching aids occupied two of the sessions, one of which was devoted to invited papers by F. E. Christensen on effective demonstration experiments and by H. Kruglak on a successful type of laboratory examination, and to a showing by V. E. Eaton of recent McGraw-Hill physics motion pictures. On Monday afternoon, the association joined with the APS for invited papers on astronomical topics.

The remaining two half-days were devoted to the discussion of general problems of particular interest to college teachers. During a round-table discussion on "Methods of accomplishing the function and mission of the AAPT," with Marsh W. White as moderator, it was brought out that the objectives of the association are twofold: (i) to enable physics teachers in colleges and universities to improve their teaching, and (ii) to further the appreciation of the role of physics in our culture. These objectives have been implemented by meetings, committees, the *Journal*, awards, and cooperative efforts with other groups, such as the American Institute of Physics. Projects that were suggested for sponsorship by the association include better methods for stimulating instruction in secondary schools, a definite program for the training of physics teachers, investigations of methods of teaching, and cooperative efforts to interest more students, particularly those in secondary schools, in physics and mathematics. The *American Journal of Physics* is a valuable aid in these fields of activity, since, as T. H. Osgood pointed out, its aims are educational, informative, pedagogic, professional, and inspirational, in contrast to the aims of the purely archive journals. It was recommended that



commissions (expanded committees) should be appointed to work on these projects and that they should be enthusiastically and actively supported.

The second discussion, led by J. G. Potter, was concerned with the "Report of the ASEE symposium on physics in engineering education," a report that was both surprising and disturbing. Engineers are dissatisfied with the way the physicists are teaching physics to the engineers. They would "relieve" the physicists of teaching mechanics, heat, and electricity (light and sound seem to have been lost sight of) and would ask them to concentrate at the senior level on modern physics and the solid state. The physicist does recognize that drastic surgery is needed in teaching elementary physics, but he believes that the fundamental roots should be deeper rather than shallower; he is quite content to leave the applications to the engineer. Both groups, physicists and engineers, need tolerance and cooperation in dealing with these problems. The two associations will meet conjointly at Pennsylvania State University in the summer of 1955.

The final discussion was on the "Preparation of college teachers" and on the "Training of graduate student assistants." In discussing the former, attempts were made to list the qualities that a college teacher of physics should have:

- 1) Knowledge or understanding (i) of his subject (with a broad grasp of the basic elements), (ii) of a wide range of subjects, thus having a broad general education and commanding the respect of the students, and (iii) of the implications of physics with respect to the present world.
- 2) Ability to convey knowledge to the student in such a way that he is activated to think for himself, an ability that demands a vital interest in young people.
- 3) Interest and capacity to become a constructive member of the faculty, which involves acquaintance with the issues of higher education and their relationship to modern society.

To these qualities, many of which were suggested by R. M. Cooper, chairman of general studies at Minnesota, T. H. Osgood added, as criterions, politics (which was not discussed), creativity, good personal impression, "drive" as indicative of usefulness, and lucidity of explanation, with experience and interest in teaching. It was further brought out that the good teacher has a real concern for the student as an individual, an adult point of view, and a realization of his responsibilities. The suggestion was made that a teacher's moral and religious philosophy of life should be compatible with that of the institution involved and should be a live issue in his life.

Certain graduate schools give special training to those going into college teaching. However, many prospective teachers get their training by serving as laboratory assistants. For these latter, many institutions have regular meetings with the professor in charge of the laboratory, at which time there is a discussion of appropriate teaching techniques and of problems that may arise with respect to the theory and operation of the experiments. The chief failures have been in not

giving these assistants clear ideas of the underlying philosophy of laboratory work and a realization of their importance in the over-all scheme of the course. Only a few institutions require the assistants to work through the experiments themselves. In the ensuing discussion, another side to the question was brought out: namely, that a conscientious and interested assistant may need to be protected from spending too much time on laboratory assisting.

The superb total eclipse of the sun was, of course, the highlight of the whole meeting. No clouds obscured the view; 76 sec was all too short to gaze upon the beauty of the corona. A debt of gratitude is owed to J. W. Buchta of Minnesota who was responsible for the idea of inviting the AAPT and the APS to meet in Minneapolis, since the successful viewing of the eclipse will be remembered long after many details of this meeting have faded.

MILDRED ALLEN

Mount Holyoke College, South Hadley, Massachusetts

## Science News

That the notorious Piltdown affair is even more of a fraud than was at first suspected was revealed at the 30 June meeting of the Geological Society of London [*Nature* 174, 61 (10 July 1954)]. Representatives of anthropology, anatomy, dentistry, chemistry, mineralogy, and art analysis reported on various aspects of the problem. Further studies not only have confirmed the earlier conclusion that the teeth of "Piltdown man" are artificially altered (W. E. Le Gros Clark, J. S. Weiner), but also have demonstrated that the chin region of the broken lower jaw resembles that of an orang-utan (Weiner) and that the fragments of the so-called "turbinal bone" are actually those of a small limb bone of some animal (Clark).

Radiometric assays (S. H. U. Bowie and C. F. Davidson) of the Piltdown vertebrate remains indicate that the primate fragments are Holocene rather than Pleistocene. The other vertebrate remains give a remarkably wide range of radioactivity: the teeth of *Elephas* differ from any British mammalian bones of Tertiary or later age studied and resemble a specimen from Tunisia, and the hippopotamus teeth and some of the beaver bones are quite unlike any other British or foreign Tertiary fossils examined. Accordingly, it appears certain that the bones of the Piltdown "assemblage" had very different geologic and geochemical histories. Mineralogic and chemical tests were reported (G. F. Claringbull and M. H. Hey). Although R. C. Hoather and C. Bloomfield found the gravel and loam from the site and from nearby ground water to be notably low in sulfate content, x-ray diffraction studies revealed mixtures of apatite and gypsum in the Piltdown cranium, and gypsum was later found in many other Piltdown specimens. In experiments on white bone from a neolithic skull, a solution of weak iron alum produced a full-brown color accompanied by conversion of the apatite to gypsum. Since no nat-

ural conditions seem likely to have produced this effect, it appears that the gypsum in the Piltdown specimens was incidental to artificial treatment by iron solutions in order to produce brown staining.

In summing up, K. P. Oakley emphasized that other tests confirm the entire recency of the Piltdown mandible: its organic content is that of fresh bone; and J. T. Randall and A. V. W. Martin, using the electron microscope, found intact collagen fibers in the mandible but not in the brain-case. Oakley reported that A. E. Werner and R. J. Plesters had identified the black coating on the canine tooth as a paint, probably Vandyke brown. It is indicated, therefore, that both the Piltdown skulls I and II are fraudulent; however, on the basis of their composition they are not modern like the mandible, but subfossil though post-Pleistocene. All of the Piltdown flint "paleoliths," Oakley said, are artificially stained, and the worked elephant bone could not have been carved while fresh. From the total evidence, it was judged that the Piltdown bones and teeth had been assembled from a wide variety of sources, some of them foreign. For its low nitrogen and low fluorine content, the hippopotamus molar tooth can be matched only by cave-deposit material, for example, in Malta.

The only dissenter on the symposium was A. T. Marston, who, on the basis of attempts at staining modern bone and experiments with teeth, reiterated his belief that, although the Piltdown jaw and canine tooth are those of an ape and unrelated to the skull fragments, they have not been deliberately faked. From the evidence now brought together, however, it seems virtually indisputable that the Piltdown finds represent a deliberate fraud of almost unbelievable elaborateness. Indeed, it appears likely that none of the specimens are native to Piltdown. However, as Sir Gavin de Beer emphasized, the author of the hoax remains unknown. And, it might be added, the motive remains a matter of speculation of special interest to psychologists and psychiatrists.—W. L. S., Jr.

The Carnegie Institution of Washington has announced that radio astronomical observations have begun with a new **narrow beam cross antenna** built at Seneca, Md., by the institution's department of terrestrial magnetism. F. Graham Smith, visiting investigator from the Cavendish Laboratory, Cambridge, England, and Harry W. Wells and Bernard F. Burke, staff members of the department, cooperated in the development of the antenna array, which occupies a flat 90-acre field and consists of 128 dipoles arranged along the two diagonals of the field. Each line of 64 dipoles is 2040 ft long, and the dipoles are connected to a central point by a branched feeder system. At the central point is a receiver which is sensitive only to signals picked up simultaneously in both lines of dipoles. The effective angular resolving power corresponds to that of an area of about 50 acres covered with dipoles. With the feeder cables of equal length, the antenna beam is directed straight upwards and receives radio waves from any object which crosses

the zenith. By adjusting the feeder lengths, the beam may be directed toward any part of the northern sky.

The new principle in the construction of antennas of high resolving power at long wavelengths was first used by B. Y. Mills in Australia, and his antenna, known now as the "Mills Cross," largely inspired the design of the present one, which is for a wavelength of 14 m.

Although the earliest radio-astronomical observations were made at long wavelengths—around 20 m—most of the recent work has been carried out at shorter wavelengths where better angular resolution can more readily be obtained. Examples of large antennas for this work are the large dish under construction at Manchester, England; the dish to be built in Australia (see cover *The Scientific Monthly*, September); the interferometer in Cambridge, England; and a large antenna at Ohio State University. These are mostly used at wavelengths in the region of 1 m or less.

The Seneca installation returns to an intermediate wavelength. It will be used for the study of radio radiations not only from the sun and radiating gases in our galaxy, but also from radiating gases in other galaxies. In this latter class of objects, several appear to be associated with the collisions of galaxies. An enormous amount of radio noise appears to be generated by this process, although the power received on the earth is small since these collisions are occurring many millions of light years away.

The Na and K values of mammalian red cells can be accurately and rapidly estimated by **flame spectrophotometry** according to R. E. Bernstein in a paper in a forthcoming issue of *Science*. The movement of Na and K into and from mammalian red cells is an active process dependent on erythrocyte glycolysis, in contrast to the diffusion process for anions and hydrogen ions. It can be calculated that a red cell lacking a K transport system would have a pH of about 6.0 and would contribute less effectively to oxygen carriage and the acid-base equilibrium of the blood.

A technique by which a so-called "**wisdom tooth**" can be transplanted to take the place of a missing permanent molar in the mouth of the same individual was described in a recent issue of the *Journal of the American Dental Association* by Merle L. Hale, professor of oral surgery at the College of Dentistry, State University of Iowa. He cautioned, however, that the procedure can be carried out effectively only on carefully selected persons.

The Military Operations Subcommittee of the House Committee on Government Operations, under the chairmanship of Rep. Riehlman (R, N. Y.), after having conducted extensive hearings, has issued a report that severely criticizes the Department of Defense for its administration of scientific research and development. The Riehlman subcommittee stresses that it is especially important to improve the personnel security clearance policies.

The U. S. Department of Agriculture states that the **Khapra beetle**, an insect unknown on this continent until last November, has been found infesting grain warehouses in 12 counties in California, Arizona, and New Mexico. USDA entomologists, who are familiar with the insect's destructive grain-feeding habits in many European and Asian countries, say that it could become a serious pest in the southern states and, possibly, could establish itself in heated mills and warehouses in the North.

A fundamental difference exists between the English and continental attitudes toward the development of **atomic energy** programs, according to D. J. Hughes of the Brookhaven National Laboratory in a recent issue of *Nucleonics*. The British view is that Britain itself should develop all phases of atomic energy, whereas continental scientists are more inclined to co-operate among themselves, with the British, and with the United States.

The British attitude is based not so much on the present lack of exchange of information, but more on the feeling that the only way to develop a sound and substantial atomic energy industry is to become expert in all of its aspects. The British program covers all phases, the article notes, in a planned, orderly way so that, while practical results will be felt as soon as possible, over-all understanding will be promoted simultaneously.

The dwindling coal supply which makes Britain's need for some other source of power acute is well known, but not so well known is the fact that French scientists feel that atomically produced electricity is urgent for their country. Emphasis in other European countries also is on power development.

A striking characteristic of neutron physics research both in England and France is the concentration on basic pile physics. The intense interest of the Europeans in the basic neutron physics of reactors is revealed in plans for piles intended exclusively for research. In this respect, the article points out, the possible superiority of European research piles to ours in the next few years deserves serious consideration.

The **nautical mile** used in navigation on sea and in the air is now a little more than 4 ft shorter than it used to be. The National Bureau of Standards has announced that by international agreement the international nautical mile of 6076.1 ft will be used instead of the U.S. nautical mile of 6080.2 ft.

J. F. Gates Clarke, U.S. Department of Agriculture entomologist now working at the U.S. National Museum, Smithsonian Institution, collected between 50,000 and 60,000 specimens during a 3½-mo exploration of the 43-mi<sup>2</sup> area of **Kusaie**, an island in the Carolines. Between 800 and 900 distinct insect species have already been found by scientists now studying Clarke's collection.

One of the strange specimens brought back is a

giant spider, grayish-brown and 4 in. long, that wears "rubbers"—bristle groupings on its feet that let it run swiftly over the surface of jungle streams. Living on rocks in and alongside the streams were black crickets about an inch long that chirped continuously; when frightened, they dived into the streams and swam underwater. Blue-green walking sticks, 7 to 9 in. long with 2-in. legs, were found in the trees. Only one type of tick and three varieties of butterfly were discovered on the island. The majority of insects on the island are harmless, because they feed on dead or decaying vegetable matter.

Papers reporting the survey of Kusaie and other islands will be published in Honolulu under the auspices of the Bishop Museum. The work is sponsored by the Office of Naval Research and the Pacific Science Board of the National Academy of Sciences-National Research Council.

The Memorial Library of the Texas Medical Association has reported that conventional fiber laundry cases have proved to be extremely satisfactory containers for the **two-way shipment of medical journals** and other library reference materials to individual physicians. Materials are returned promptly in good condition.

The foundations of a **Roman farmhouse** were recently discovered in a Westphalian excavation. A little earlier, a Gallo-Roman temple had been found nearby. Both relics stem from the 2nd century B.C. The farmhouse is 60 ft wide and 96 ft long. A floor equipped with heating pipes has survived as well as seven steps leading into a cellar. The period of the building's construction was estimated from coins and articles of earthenware found in and around the house.

These paragraphs are excerpts from an article on **federal support of hospital construction** in Massachusetts by A. D. Rubinstein in the 29 July issue of the *New England Journal of Medicine*.

During the year 1947 an unprecedented and far-reaching experiment in hospital administrative research was initiated . . . throughout the country. Simultaneously throughout the 48 states, Alaska, and Hawaii, after a detailed inventory of existing facilities according to a predetermined plan, federal funds became available on a matching basis for hospital and health-center construction. For the first time in the history of the nation, hospital building was to be undertaken according to one master plan; what may appear to be unbelievable was the certainty that under the provisions of the Hospital Survey and Construction Act (Public Law 725), the American voluntary hospital system was to maintain the independent position it had enjoyed since its inception.

To be sure, there were many who believed that socialized medicine and all the evils it represented would insidiously ensnare first the hospitals and finally the entire system of medical care. It will be recalled that early in the history of this program in Massachusetts the boards of trustees of at least two hospitals, in spite of the availability of federal funds, decided to proceed alone rather than risk the possibility of federal entanglements and

ultimately the loss of control of their institutions. It was difficult to believe that acceptance of federal funds would not, in one way or another, subject the hospital to outside influence and restraining pressures.

Fortunately, these fears proved to be groundless; there were no federal controls. Hospitals aided under the program have maintained absolute freedom of action, and hospital trustees and staffs were completely won over.

## Scientists in the News

**A. E. Axelrod**, associate professor of biochemistry at the Institute of Pathology of Western Reserve University Medical School since 1951, has been appointed professor of biochemistry in the University of Pittsburgh School of Medicine. Prof. Axelrod has published a large number of research papers in the general field of nutrition and enzymology.

**Ellis V. Brown**, formerly at Fordham University, is now teaching biochemistry at Seton Hall College.

**David B. Camp**, formerly associate professor of chemistry at the University of South Dakota, is now associate professor at the University of the South.

New members of the department of agronomy and genetics at West Virginia University are **Maria Hilliard Cartledge**, **Clyde C. Dowler**, and **Thomas R. McCarroll**.

**Francis B. Gordon**, previously chief of the virus and rickettsia division at Camp Detrick, Frederick, Md., became head of the virology division, Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md., effective 1 Aug.

**Robert B. Green**, formerly associate professor at Stevens Institute, is now head of the physical research department of Baker & Co., Inc.

**Horace S. Isbell**, head of carbohydrate research in the National Bureau of Standards, will be honored by the American Chemical Society's Division of Carbohydrate Chemistry as "Man of the Year" at the society's 126th national meeting in New York in September. **Allen V. Astin**, director of the bureau, will be the principal speaker at a divisional dinner for Dr. Isbell in the Hotel New Yorker on 15 Sept. Dr. Isbell will receive a scroll citing his achievements and contributions to carbohydrate chemistry.

**Ernst H. Krause** has resigned as associate director of research at the Naval Research Laboratory in Washington, D.C., to become director of research laboratories in the missile systems division of Lockheed Aircraft Corp. at Van Nuys, Calif. Dr. Krause has long been closely associated with missile and nuclear weapons development work for N.R.L., the Los Alamos Scientific Laboratory, and the Atomic Energy Commission. Lockheed has appropriated \$10 million to build and equip new laboratories and to institute research

work. The laboratories will adjoin present facilities of the missile systems division.

Another new member of the Lockheed division is **Montgomery H. Johnson**, who will be associate director. Dr. Johnson has served on the radiation laboratory staffs at both the University of California and Massachusetts Institute of Technology and at U.C.'s Livermore Laboratory. His fields are atomic and nuclear physics, quantum theory, electrodynamics, absorbent materials, atmospheric physics, and ionosphere research.

The staff as so far organized will also include **Eric Durand**, who has resigned as associate director of Chicago Midway Laboratories. Dr. Durand's fields are solid-state physics, radiation, infrared navigation, test range instruments, rockets, bombing aids, and ordnance devices. Other new appointees are **Edward J. Zadina**, formerly technical advisor and operations analyst for the U.S. Air Force Special Weapons Center, Albuquerque, N. Mex., and **Henry R. Senf**, until recently acting director of development, Air Navigation Development Board, Civil Aeronautics Administration.

Announcement has been made of the appointment of **Ralph W. Kumler** to the staff of Foster D. Snell, Inc., New York, as a pulp and paper consultant.

**Douglas H. K. Lee**, professor of physiological climatology at Johns Hopkins University, has been invited to lead the 4th study meeting of the European Association for Animal Production to be held at Lucerne, Switzerland, 25 Sept.-2 Oct. in a discussion of "The influence of tropical and sub-tropical climate on animal production."

**Walter J. Murphy** of Washington, D. C., American Chemical Society editor, will receive a scroll of honor in recognition of his services to the chemical profession during the society's 126th national meeting in New York in September. The scroll will be presented by the ACS Division of Industrial and Engineering Chemistry at a luncheon in the Hotel Statler on 15 Sept. The Division of Chemical Literature and the Division of Chemical Marketing and Economics will cosponsor the event with the Industrial and Engineering Division.

Former chief of the engineering division for the U.S. Air Force in Europe, **James L. Murray**, has joined the Garrett Corp. as engineering representative.

**Pandhari-Nath Prabhu**, who has been reader in applied psychology and social research at the Tata Institute of Social Sciences, Bombay, is now head of the new psychological laboratory that was set up in the Institute when it moved into its new building at Chembur, near Bombay, in June. Work on the applications of psychology in industry and in experimental social psychology is planned at the laboratory. The address of the Institute is Devnar, P.O. Chembur, Bombay 38, India.



**Samuel L. Raines**, assistant professor in the department of urological surgery at the University of Tennessee College of Medicine, is to succeed Thomas D. Moore as professor and head of the department.

Announcement has been made of the appointment of **Laszlo Reiner** as staff consultant to Food Research Laboratories in the fields of pharmacology, toxicology, and medicinal chemistry. Formerly with the Burroughs-Wellcome & Co., and Wallace and Tiernan, Dr. Reiner is well known for his development of the first depot-insulin preparation and a number of dermatologic preparations.

**Henry Salvatori**, president of Western Geophysical Co. of America, has been elected to the board of directors, Consolidated Engineering Corp. He has earned recognition for pioneering geophysical oil exploration techniques that have become industry standards.

New director of research for the Weapons Systems Evaluation Group, Department of Defense, is **William Shockley**, former research physicist of the Bell Telephone Laboratories. Primary function of the WSEG is to respond to calls for service and assistance from the Joint Chiefs of Staff and the Assistant Secretary of Defense (Research and Development) for analytical studies and evaluations of the comparative effectiveness and costs of present and future weapons systems.

**Roy W. Simonson**, director of soil classification and correlation in the national soil survey of the U.S. Department of Agriculture, Washington, D.C., recently spent 2 mo as consultant to the Ministry of Agriculture in Brazil. Sponsored by the Foreign Operations Administration, his mission was to advise the Ministry on the program being initiated for the classification and mapping of the soil resources of the country.

Professor of statistics at Iowa State College, **George W. Snedecor**, has been elected an honorary fellow of the Royal Statistical Society "in consideration of the eminent services rendered to statistics."

**Eugene M. Sporn**, biochemist, has transferred from Camp Detrick, Frederick, Md., to the office of the chief chemical officer, Washington, D.C. He has been engaged in research with the Chemical Corps for the past 7 yr.

**H. F. Sykes, Jr.**, Col., has been transferred from the staff of the Army War College to assume command of the main research center of the Corps of Engineers, the Engineer Research and Development Laboratories at Ft. Belvoir, Va.

**Elza Turner**, formerly with the New York Polyclinic school and hospital, is now director of nursing education at South Dakota State College. The nursing education program is conducted jointly by the college and Sioux Valley hospital of Sioux Falls.

**Edwin M. Vaughan** is returning from the Army in September to the position of chairman of the physics department at St. Ambrose College, Davenport, Iowa. For the past year and a half he has been in Germany instructing officers of NATO countries in technical and tactical applications of atomic weapons.

Two new staff members of the Stanford Research Institute are **James H. Wakelin**, who left Textile Research Institute to become a consultant at SRI, and **E. Finley Carter**, of Sylvania Electric Products, Inc., who has become manager of research operations at the institute.

**Fletcher G. Watson**, associate professor in the Harvard Graduate School of Education, will be James Bryant Conant lecturer on science education in the School of Education for 1954-55. Trained as an astronomer, Dr. Watson has conducted several major studies of science teaching in the secondary schools.

A year-long research study aimed at evaluating and improving Ohio's services for the delinquent child has been undertaken by the Bureau of Educational Research at Ohio State University. **H. Ashley Weeks**, a visiting professor from New York University's graduate department of sociology, is director of the study.

The International Nickel Co., Inc., has announced the appointment of **W. Andrew Wesley** as manager of the Bayonne research laboratory. He succeeds **Norman B. Pilling**, director since 1939, who becomes assistant to the vice president-manager of the company's development and research division in New York. **John T. Eash** becomes assistant to Dr. Wesley.

**Ernest T. F. Wohlenberg**, of Ukiah, Calif., has been appointed to the newly created post of professor of industrial forestry at the Yale University School of Forestry. He will head a new graduate program of teaching and research in the problems of private forestry enterprises.

This new professorship is perhaps the first of its kind in American forestry education. It is supported by the Edward Hines Lumber Co. through the Ehleo Foundation of Chicago, Ill., and by the Michigan-California Lumber Co. of Portland, Ore. Prof. Wohlenberg will retire in September as vice president of the Masonite Corp. and general manager of its California operations. He will assume his new duties at the beginning of the fall semester.

**Bernard Wolnak** has resigned as research and consulting chemist with the Miner Laboratories in Chicago to open his own consulting, research, and development laboratories.

**John Kirtland Wright**, geographer-historian, has been awarded the Charles P. Daly medal of the American Geographical Society for his outstanding contributions to geography through his administrative services, writing, and research. Dr. Wright is a research



associate of the society. He joined the society's staff in 1920 as librarian and served until 1938 when he became director; in 1949 he resigned this post and since then has devoted his time to research and writing.

Syntex, S. A., of Mexico City has promoted **Alejandro Zaffaroni** from director of biochemical research to director of research, and **Arthur D. Odell** from director of process development to director of production and engineering.

The following are recent appointments at South Dakota State College. **Leon F. Bush**, and **Leo E. DuBose**, animal husbandry; **Everett McC. White**, agronomy; **Harmon E. Calkins**, dairy husbandry-bacteriology; **Joe G. Hennen**, plant pathology; **Louis G. Skubic**, mechanical engineering; **Harvey C. McKenzie**, mathematics; **Warren O. Essler**, electrical engineering; **Glenn Atkinson**, **Frederick Kurpjuweit**, and **Russel Walsh**, agronomy.

## Meetings

Nearly 300 of the nation's ornithologists are expected to attend the annual meeting of the **American Ornithologists Union** to be held 8-12 Sept. at the University of Wisconsin. More than 30 scientists will present research papers that will include reports on banding projects, migration studies, environmental influences, taxonomic and anatomic studies, cycles, local problems of management, songs and calls, hybridization, reproduction studies, ecological and distribution studies, and many other subjects. In addition, two special symposiums are scheduled—one on bird behavior and the other on how the amateur can contribute to ornithological science.

Leaders in the administration of scientific research will meet at New York University, 8-10 Sept., for the 8th annual **Conference on the Administration of Research**. Approximately 250 persons, heads of educational, industrial, and government research units are expected to attend the meeting, which coincides with the opening of the centennial celebration of the university's College of Engineering.

Through case studies, the conferees will consider communications problems in research operations, management and physical facilities for research, the appraisal and reward of research output, and the place of basic research in an applied research laboratory. Past conferences have included discussions of security restrictions in government-sponsored research; international problems; selection, control, and termination of research projects; qualifications of research executives; and many aspects of the financing of research.

The conference was initiated in 1947 by a group of men who, not previously accustomed to administering large organized research groups, had been placed in charge of rapidly expanding laboratories established

during World War II. A long list of distinguished speakers on this year's program includes **Allan V. Astin**, director, Bureau of Standards; **Norris E. Bradbury**, director of the Los Alamos Scientific Laboratory; **Ralph Bown**, vice president, Bell Telephone Laboratories; and **Helmut E. Landsburg**, chief, Climatological Services Division, U.S. Weather Bureau.

The **International Society of Clinical Pathology**, the **International Society of Geographic Pathology**, and the **International Association of Medical Museums** will meet concurrently in Washington, D.C., 6-10 Sept. The planning committee expects approximately 140 overseas guests from 31 countries; many of these are invited speakers. The program of the Conference on Geographic Pathology will be devoted entirely to cancer, that of the Congress of Clinical Pathology will include all aspects of clinical pathology, while the meetings of the International Association of Medical Museums will emphasize both the role of pathology in medical education and the teaching of pathology and clinical pathology.

Following the joint opening session of the three organizations, the College of American Pathologists will sponsor a symposium on diseases caused by fungi. There will be two joint scientific sessions, one on the geographic distribution of cancer and another on the geographic distribution of diseases other than cancer. The American Society of Clinical Pathologists will conduct its regular seminar on the day after the congress. The subject will be "Diseases of the skin" and all overseas registrants will be guests of the society.

The **8th National Chemical Exposition**, which is to take place in the Chicago Coliseum, 12-15 Oct., will also be a center for a series of chemical meetings and other activities. Among the organizations scheduled to meet during the exposition are the Manufacturing Chemists' Association, the Chemical Market Research Association, the Society of Chemical Industry, and the Purchasing Agents' Association. For details write to the exposition headquarters at 86 E. Randolph St., Chicago 1.

The **National Electronics Conference** will take place in Chicago, 4-6 Oct., and the first national annual meeting of the **Professional Group on Nuclear Science** of the Institute of Radio Engineers will be held 6-7 Oct. Both meetings are scheduled for the Hotel Sherman.

A symposium on the "Nutritional aspects of blood formation," made possible by support from the National Vitamin Foundation, will be held at the University of Cincinnati on 22 Oct. The meeting is open to all interested physicians and scientists.

On 14-15 Oct. the Columbia University College of Pharmacy is sponsoring a conference, entitled "Pharmacy and the conquest of disease," that will be dedicated to the advances made in recent years in the treat-

ment of disease and in public health and to a forecast of future research developments. It is a part of the year-long observance of Columbia's bicentennial and also a tribute to the 125th anniversary of the founding of the College of Pharmacy.

A comprehensive examination of plastic products—their utilitarian and decorative uses and their increasing role in the light and heavy construction industries—will highlight a conference on **Plastics in Building** scheduled for 27-28 Oct. at the National Academy of Sciences in Washington, D.C. The conference is sponsored by the Society of the Plastics Industry, Inc., the Manufacturing Chemists' Association, and the Building Research Advisory Board. The meeting, the first of its kind, is expected to attract architects, designers, engineers, builders, and manufacturers of component parts of buildings. Fifteen speakers have been scheduled, and a summary session will be conducted by two speakers, one representing the plastics industry and one the building industry. Each session will have a discussion period to explore the practical, as well as the theoretical, uses of plastics in construction.

### Society Elections

**American Neurological Association:** pres., Percival Bailey; pres.-elect, J. M. Nielsen; 1st v. pres., A. R. Vonderahe; 2nd v. pres., Paul C. Bucy; sec.-treas., H. Houston Merritt.

**American Pomological Society:** pres., A. S. Colby, University of Illinois, Urbana; vice presidents, A. Grant Fox, Simcoe, Ont., Canada, and W. P. Judkins, Virginia Polytechnic Institute, Blacksburg; sec.-treas., Ronald B. Tukey, Purdue University, Lafayette, Ind.

**American Society for Metals:** pres., George A. Roberts, Vanadium-Alloys Steel Co., Latrobe, Pa.; v. pres., A. O. Schaefer, Midvale Co., Nicetown, Pa.; sec., W. H. Eisenman, Cleveland, Ohio; treas., W. A. Pennington, The Carrier Corp., Syracuse, N.Y.

**Hawaiian Academy of Science:** pres., Colin G. Lennox, Honolulu; pres.-elect, William A. Gortner, Pineapple Research Institute, Honolulu; sec., Doak C. Cox, Hawaiian Sugar Planters Association Experiment Station, Honolulu; treas., Beatrice Krauss, Pineapple Research Institute, Honolulu.

**Pacific Southwest Association of Chemistry Teachers:** pres., Howard Benninghof, San Francisco City College; vice presidents, E. B. Womack, Fresno State College, and Roy Newsom, Whittier College; sec., Mother Agnes Schmit, San Francisco College for Women; treas., Sister Agnes Ann, Immaculate Heart College, Los Angeles.

**Phi Sigma Society:** chancellor, Karl F. Lagler, University of Michigan, Ann Arbor; v. chancellor, Erwine Hall Stewart, Mesa, Colo.; exec. sec., Fred S. Oreutt, Virginia Polytechnic Institute, Blacksburg; treas.,

Tema Shults Clare, University of Southern California, Los Angeles.

**Society for Non-Destructive Testing:** Gerold H. Tinney, Los Alamos Scientific Laboratory; Wm. C. Hitt, Douglas Aircraft Corp., Santa Monica, Calif.; sec., Philip D. Johnson, Evanston, Ill.; treas., Hamilton Migel, Magnaflux Corp.

### Education

President Eisenhower has appointed a **Cabinet committee on the training of scientists and engineers**. The committee includes the secretaries of Commerce, of Labor, and of Health, Education, and Welfare; the Assistant Secretary of Defense for Manpower; and the directors of the Atomic Energy Commission, the National Science Foundation, and the Office of Defense Mobilization. The committee, appointed in May, held its first meeting on 21 July. Realization of the rapid advances in Soviet science and technology, and of the phenomenal growth of Russia's manpower pool of engineers, scientists, and technicians, in contrast to the shrinkage of our professional output, was a factor in prompting the Presidential action.

A census of engineering and science teachers, compiled by the Educational Directory, University of Chicago Press, represents a count of faculties in colleges, universities, and junior colleges in the continental U.S. during the second semester of the academic year 1953-54.

**Biological sciences**, 28,168: medical (does not include physicians or nurses), 12,945; general, 5499; agriculture, 5795; psychology, 3929.

**Physical sciences**, 17,459: astronomy, 305; chemistry, 5916; geology, 1205; mathematics, 5290; physics, 4208; meteorology, 132; statistics, 403.

**Aeronautics**, 2297.

**Atomic energy**, 193.

**Engineering**, 8648: chemical, 726; civil, 1528; electrical, 1803; industrial, 422; mechanical, 2118; mechanical drawing, 709; mining, 155; metallurgy, 440; miscellaneous, 746.

**Naval science**, 476.

In the junior colleges 4110 teachers are listed in the following fields: aeronautics, 69; agriculture, 371; biology, 644; chemistry, 540; earth sciences, 155; engineering, 589; general science, 348; mathematics, 1064; physics, 330. In addition to the 61,351 teachers included in this count, there are 6382 in medicine, 4514 in home economics, 2298 in nursing, and 1592 in health and hygiene.

Eight speakers are scheduled for the **Frontiers in Chemistry lecture series** at Wayne University this fall. The series is cosponsored by the International Society of the Friends of the Kresge-Hooker Library and Wayne's chemistry department. On 4 Oct. Sune Bergstrom of the University of Lund (Sweden), will deliver the first lecture, on "Formation and the metabolism of bile acids."

The other lecturers and their subjects are: 8 Oct., Hans Schmid, University of Zurich, "Chemistry of some natural products from tropical plants"; 18 Oct., Anton B. Burg, University of Southern California, "Chemical consequences of the borine group,  $BH_3$ "; 25 Oct., R. Norman Jones, National Research Council, Ottawa, Canada, "Infrared spectrometry—a tool in research in organic chemistry"; 1 Nov., P. W. Selwood, Northwestern University, "Thermomagnetic analysis and structure of supported nickel catalysis"; 8 Nov., to be announced; 15 Nov., Donald D. DeFord, Northwestern University, "Coulometric titrations"; 22 Nov., J. O'M Bockris, University of Notre Dame, "Structure of liquid silicates."

All professionally interested persons are invited to attend the lectures. Additional information may be obtained through Dr. Wendell H. Powers, Wayne University, Detroit, Mich.

The first laboratory in Latin America to utilize radioactive carbon to determine the age of archeological, geologic, and paleontological specimens is being established at the University of Mexico. Agosto Moreno y Moreno will head the new laboratory.

Reports made at the end of the first year of operation of the open-stack system in the University of Georgia's Ilah Dunlap Little Memorial Library show an 85-percent increase in student use of nonreserve volumes over that of the preceding year. Faculty use of the library increased almost 18 percent. Rare books and certain collections are the only materials still kept in traditional library fashion rather than placed in open stacks.

A new School of Dentistry building is under construction on the Loma Linda campus of the College of Medical Evagénists. The 2-story structure will include 132 dental operating units and chairs, lecture halls, and laboratories for teaching and research. The estimated cost of the building and equipment is approximately \$1 million.

Camera equipment valued at \$1235 has been given to South Dakota State College by the Stephen F. Briggs and Beatrice B. Briggs Foundation. Previous donations of equipment by the foundation for use by the department of photography and audio-visual education total more than \$6377.

Stanford University scientists, now moving into their new \$200,000 Microwave Laboratory, are starting construction of another electron linear accelerator to be known as "Mark IV."

Tufts College has announced a new cooperative program with the General Electric Co. of Lynn, Mass. Under the plan, which goes into effect this fall, the company will send a group of selected students to the Tufts Engineering School to study mechanical engineering in a 4-yr apprentice-training program leading to an associate degree in science.

A plan to raise the level of medicine in Indonesia has been initiated by the University of California School of Medicine, San Francisco, with the financial aid of the Foreign Operations Administration. Under terms of a contract between the university and F.O.A., the medical school will cooperate with the University of Indonesia in the training of medical educators and doctors. F.O.A. is providing \$692,000 to support the 3-yr program. Francis S. Smyth, former dean of the School of Medicine and at present professor of pediatrics, is director of the plan, called the Indonesian Project in Medical Education.

Under the program the university will send 10 American medical educators to serve on the medical faculty in Djakarta, and in turn the University of Indonesia will send doctors here for training in American medical education techniques. The first American to go to Indonesia is William R. Lyons, professor of anatomy in the School of Medicine and a noted researcher in endocrinology. Dr. Smyth is making arrangements with other scientists, on the University of California and other faculties, to take temporary posts at Djakarta.

A \$100,000 expansion of research and educational services is underway in the University of Georgia's School of Forestry. It will provide for extensive study of forest genetics and silviculture and a broadening of the Forestry School's program of study at the graduate level. All research will be done in cooperation with the college's experiment station.

During the coming academic year the University of Texas department of chemistry will have four visiting lecturers. Peter Debye of Cornell University will speak in October; Joel H. Hildebrand of the University of California at Berkeley will discuss education for science, 22-24 Nov.; George B. Kistiakowski of Harvard University will lecture 24-25 Jan.; and next spring Farrington Daniels of the University of Wisconsin will discuss solar energy and photosynthesis.

Regular visits in the homes of patients, applied sociology in the form of medical social service, are the basis of the course called "Social and environmental medicine" that is required of all students in the Vanderbilt University School of Medicine. The student acts as family health advisor among selected families, continuing contact throughout his 4 yr of training.

### Available Fellowships and Awards

An annual research award established by the Aero Supply Manufacturing Co. of Corry, Pa., will give \$1000 to the engineering student who makes the greatest contribution to original research in aircraft and guided missile fuel systems. Second and third place awards will be \$500 and \$300, and there will be two \$100 "consolation" awards. The judging committee will include an officer of the Air Force's Air Research and Development Command, power plant engineers

from airframe manufacturers, an engineering professor, a representative of the American Institute of Aviation, and an Aero Supply research engineer.

The Arctic Institute of North America is offering a number of research grants in 1955 for scientific investigations dealing with the arctic and subarctic regions. Research must include either field investigations in North America or studies at one of the institute offices. Applications for grants will be considered from those who have demonstrated their ability to conduct research work of superior quality in some field of science. *Completed applications must be received before 1 Nov.* Forms may be obtained from the Arctic Institute of North America, 1530 P St. NW, Washington, D.C.

The Ciba Foundation, wishing to encourage well-conceived research relevant to basic problems of ageing, invites candidates to submit work in the field for awards for 1954-55. Five awards of an average value of £300 each are available; preference will be given to younger workers. The work submitted should be unpublished (but may be under consideration for publication) at the closing date for entries. The papers may be in the candidate's own language, but a summary in English not exceeding 500 words must be attached. Entries must be received *not later than 28 Feb. 1955*. For details write to G. E. W. Wolstenholme, Ciba Foundation, 41, Portland Pl., London, W.1.

A new series of grants to spur mental health research and to assist in opening research careers to qualified young psychiatrists and scientists in related disciplines has been announced by the National Institute of Mental Health. The new program, known as the **Mental Health Career Investigator Program**, was initiated upon the recommendation of the National Mental Health Council and is expected to enable a limited number of highly qualified young men and women to devote from 3 to 5 yr in full-time research investigations. The first grants in the new series were recently awarded to investigators at university medical schools in Maryland, Massachusetts, and Louisiana. Information and application forms are available from the NIMH's Research Grants and Fellowships Branch. *The deadline for receipt of applications for the coming year is 1 Nov.*

The National Science Foundation will award individual grants to defray partial travel expenses for a limited number of scientists who will attend the **3rd Pan-African Congress on Prehistory** to be held in Livingston, Northern Rhodesia, July 1955. Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. *Completed forms must be submitted by 1 Jan. 1955.*

The Children's Division of the Institute of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center, and the Association for the

Aid of Crippled Children, New York, have jointly announced the availability of fellowships for social workers in the field of **pediatric rehabilitation**. These fellowships provide from 6 to 11 mo of specialized clinical experience in the rehabilitation of physically handicapped children and youth. The fellowships pay a stipend of \$250 a month and are open to graduates of approved schools of social work who have had a minimum of 2 yr of experience, preferably in a hospital. Applications may be made to Miss Florence I. Mosher, Children's Division, Institute of Physical Medicine and Rehabilitation, 400 E. 34th St., New York 16.

## Grants and Fellowships Awarded

The July allocations of the **Damon Runyon Memorial Fund for Cancer Research** amount to \$126,890.

Lobund Institute, University of Notre Dame. Germ-free life as a biological tool for cancer research, \$19,000.

J. Heyman, Radiumhemmet, Stockholm. Tour of several countries to study results of treatment of carcinoma of the uterus, \$8000.

American Museum of Natural History. C. M. Breder, Lerner Marine Laboratory. Environmental endocrine control of cell proliferation, \$10,000.

Sloan-Kettering Institute. Environmental factors in cancer of the respiratory and upper gastrointestinal tracts, \$20,000.

State University of New York. P. J. Fitzgerald. Tests of cervix and lung cancer, \$9450.

University of Louisville. Evaluation of diagnostic radioisotope procedures in brain tumor localization, \$7350.

Institute for Cancer Research, Lankenau Hospital Research Institute, Philadelphia. Analysis of neoplastic cell populations with special emphasis on the immunogenetic and metastatic properties of component cell types, \$13,500.

University of California, Los Angeles. Mechanism of metallo-antagonism in relation to tumor chemotherapy, \$12,000.

University of Delaware. Factors influencing recovery of roots *Zea mays* after exposure to sublethal doses of x-rays or nitrogen mustard compounds, \$2900.

Wayne University. Identification of steroids by rotary dispersion, \$4590.

Michael Reese Hospital. Factors controlling the genesis of neoplasms, \$13,600.

This year for the first time the **National Fund for Medical Education's** awards to the nation's medical schools will reach more than \$2 million. The grants, totaling \$2,176,904.71, represent an increase of 12 percent over 1953 and bring to just under \$7 million the total awarded by the Fund since 1951 when the first grants were made. Business corporations contributed \$1,075,326.40 through the Fund's Committee of American Industry, and the balance was contributed by physicians through the American Medical Education Foundation, which was set up by the American Medical Association.

Accreditation of the University of Puerto Rico School of Medicine in June 1954 brought the number of American medical schools to 80—74 4-yr schools and six 2-yr basic science schools. Each 4-yr school received \$15,000 plus \$25 per undergraduate medical student. Each 2-yr school received \$7500 plus \$25 per student. Added to these grants were the individual gifts of physicians to designated schools.

Though the grants are nearly a quarter of a million dollars larger than last year, the total still falls far



short of the annual need of \$10,000,000. Nevertheless, these contributions are evidence of a growing partnership between medicine and industry.

In June the National Institute of Mental Health of the U. S. Department of Health, Education, and Welfare awarded the following grants. The amount given is that allocated for the first year. This list does not include the 42 grants awarded for the continuation of projects previously supported by the Institute.

- J. E. Anderson and D. B. Harris, University of Minnesota. Relation of childhood behavior to adjustment in adulthood, 3 yr, \$14,796.
- A. Bandura, Stanford University. Relation of therapeutic competence to personality of psychotherapist, 1 yr, \$1851.
- D. Blockman, R. Fox, and R. Lippitt, University of Michigan. Methods for improving social acceptance and participation of rejected children, 3 yr, \$27,072.
- G. E. Blom and R. Long, Massachusetts General Hospital. Emotional factors in children with rheumatoid arthritis, 4 yr, \$17,981.
- E. W. Busse, Duke University. Effect of aging upon the central nervous system, 2 yr, \$14,534.
- L. D. Cohen, Duke University. Assessment of change in anxiety level, 1 yr, \$5400.
- J. F. Dunn and R. M. Williams, Jr., Cornell University. Social and cultural factors in adjustment of American women, 1½ yr, \$10,770.
- M. E. Drake, Vineland State School. Metabolism of phenylpyruvic acid in mental deficiency, 3 yr, \$15,869.
- M. Fink, Hillside Hospital. Perceptual changes induced by drugs and electroshock, 2 yr, \$9612.
- F. J. Gerty, A. M. Garner, and C. Wenar, University of Illinois College of Medicine. Psychosomatic disorders in children, 2 yr, \$22,396.
- E. A. Haggard, University of Chicago. Family adjustment, personality, and mental processes, 2 yr, \$14,918.
- H. F. Harlow, University of Wisconsin. Symposium on interdisciplinary research in the behavioral, biological, and biochemical sciences, 1 yr, \$8910.
- C. Landis, New York State Psychiatric Institute. Sensory and motor tests of CNS efficiency, 3 yr, \$21,956.
- D. W. Lauer, Indiana University. Response variables in classical conditioning, 2 yr, \$8760.
- N. H. Ledwith, Pittsburgh Child Guidance Center. Rorschach responses of elementary school children, 1 yr, \$9720.
- M. B. Loebe, Community Studies, Inc. Interaction patterns in a psychiatric hospital, 1½ yr, \$29,262.
- F. E. Nulsen and D. Crocker, University Hospitals. Evaluation and treatment of chronic pain, 2 yr, \$5972.
- E. Pavenstedt and D. M. Greeley, Boston University School of Medicine. Effect of maternal maturity and immaturity on child development, 2 yr, \$36,085.
- L. Phillips, Clark University. Application of developmental theory to problems of social adaptation, 3 yr, \$16,102.
- J. W. Riley, Jr., Rutgers University. Analysis of small group and interpersonal relations, 3 yr, \$13,859.
- C. R. Rogers, University of Chicago. Process and facilitation of personality change, 3 yr, \$40,000.
- W. L. Sawrey, University of Colorado School of Medicine. Role of psychological factors in production of gastric ulcers, 2 yr, \$8817.
- E. V. Semrad and M. Greenblatt, Harvard College. Relation of social interaction process and clinical changes to outcome of psychotherapy, 1 yr, \$11,930.
- E. Stellar, University of Pennsylvania. Experimental study of the behavior of the marmoset, 1 yr, \$4644.
- A. F. C. Wallace, University of Pennsylvania. Mental health aspects of cultism, 2 yr, \$10,962.

The Ramsay Memorial Fellowships Trust, University College, London, Gower St., W.C.1, has made the following awards of new fellowships in chemistry for 1954-55: J. R. Anderson, British fellowship at the University of Cambridge; G. A. Sim, Glasgow fellowship; J. A. Davies, Canadian fellowship at the University of Leeds; Georges Moralli, French fellowship at King's College, Newcastle-upon-Tyne; Casiano Al-

fonso, Spanish fellowship at the University of Birmingham; Hans Jucker, Swiss fellowship at King's College, London; O. R. Rodig, United States fellowship at the University of Manchester.

The following fellowships have been renewed: G. T. Rogers, British fellowship at the University of Cambridge; K. Saito, Japanese fellowship at University College, London; W. G. Hanger, New Zealand fellowship at the University of Cambridge; Santos Amer, Spanish fellowship at the University of Cambridge; R. H. Doremus, United States fellowship at the University of Cambridge.

The U.S. Atomic Energy Commission has announced award of 20 unclassified physical research contracts. Five are new; the remainder are renewals.

- Illinois Institute of Technology. M. L. Bender. Correlation of isotopic effect on reaction rate with reaction mechanism, \$7776.
- Oklahoma A. & M. College. E. M. Hodnett. Isotope effect in the study of chemical reactions, \$6000.
- Pennsylvania State University. C. R. Kinney and P. L. Walker, Jr. Factors affecting the mechanism of graphitization and the heterogeneous gas reactions of graphites, \$29,700.
- Polytechnic Institute of Brooklyn. R. B. Mesrobian and H. Morawetz. Radiation induced solid state polymerization, \$12,160.
- State College of Washington. S. T. Stephenson and S. E. Hazlet. Design of low-powered reactor. No monetary grant.
- Alfred University. V. C. Frechette. Graphitization of carbon, \$3925.
- Case Institute of Technology. W. M. Baldwin. Sealing of zirconium in air at elevated temperatures, \$23,000.
- University of Colorado. R. N. Keller. Scintillation properties of coordination compounds, \$8645.
- Columbia University. V. K. LaMer. Fundamental investigation of phosphate slimes, \$25,000.
- Columbia University. R. M. Noyes. Photochemical reactions of iodine, \$9750.
- Columbia University. W. A. Selke. Ion exchange chromatography, \$2691.
- Indiana University Foundation. W. B. Schaap and F. C. Schmidt. Electrochemical research in amine solvents, \$14,721.
- Johns Hopkins University. W. S. Koski. Nuclear chemistry, \$17,982.
- Massachusetts Institute of Technology. F. H. Norton. Measurement of thermal conductivity of refractory materials, \$33,984.
- Massachusetts Institute of Technology. T. Sherwood. Mechanism of mass transfer to drops, \$9960.
- University of Michigan. H. J. Gombert. Research reactor studies. No monetary grant.
- Pennsylvania State University. R. Pepinsky. Neutron single crystal structure analysis, \$11,960.
- George Washington University. T. Perros. Fluorides of the rare earth elements, \$4466.
- Western Reserve University. E. L. Pace. Thermodynamic properties of gases absorbed on solids, \$7260.
- University of Wisconsin. E. L. King. Rates and equilibria of inorganic reactions in solution, \$8618.

Research conducted this year at the University of Michigan under grants from the Horace H. Rackham School of Graduate Studies included the following projects.

- John E. Bufdach, fisheries. Temperature sense of fish.
- Ernest F. Brater, hydraulic engineering. Study of water waves striking objects.
- Philip J. Elving, chemistry. Organic electrochemical processes.
- Robert B. Harris, civil engineering. Study of the structural action of steel beams subject to torsion and direct bending.
- Paul M. Naghdli, engineering mechanics. Problem in the theory of shells.
- C. S. Rondestvedt, Jr., chemistry. Mechanisms of arylation by free radical generators.



M. L. Wiedenbeck, physics. Determination of nuclear moments of excited states.

Adam A. Christman, biological chemistry. Study of the muscle extractives carnosine and anserine.

Great Lakes Research Institute. Synoptic limnological study of Lake Huron.

Felix G. Gustafson, botany. Synthesis of B-vitamin by the root, hypocotyl, and epicotyl of the white lupine, when cultured in solution.

Robert L. Hunter, anatomy. Study of the relationship between allesterase and gonadal hormones.

Carl D. LaRue, botany. Effects of various morphogenetic factors on the morphology of the gametophytes and sporophytes of bryophytes, pteridophytes, and spermatophytes.

Gordon E. Peterson, speech. Method of speech synthesis.

Lawrence B. Slobodkin, zoology. Effect of exploitation of daphnia populations.

Alexander H. Smith, botany. Manual of the fleshy hymenomycetes of the western United States.

L. C. Stuart, zoology. Studies of the herpetofauna of the Sierra De Los Cuchumatanes of Guatemala.

Elman R. Service, anthropology. Ethnological reconnaissance of the Sierra Madre region of Mexico.

Louise A. Shier, curator, Kelsey Museum of Archeology. Research abroad in preparation for publication of a description of lamps and textiles from Egypt in Kelsey Museum's collection.

Irwin Brown, speech clinician. Drug therapy in the rehabilitation of dysphasic patients.

Russell N. DeJong, neurology, and Elizabeth C. Crosby, anatomy. Experimental studies on the central nervous system.

Robert E. Moyers, dentistry. Study of the instantaneous centers of the rotation of the jaw.

Albert H. Wheeler, bacteriology. Immunologic studies to resistance to induced and transplantable tumors in tissue treated mice.

L. M. Legatski, civil engineering. Use of iteration techniques with a matrix analog computer for the solution of space frameworks.

Robert W. Parry, chemistry. Reduction of complex ions at a streaming electrode.

Donald B. Canham, physical education. Comparative study of European physiological experiments and training.

John Carow, director of Camp Filibert Roth. Adaptation of the bitterlich angle count method to the estimation of pulpwood volumes.

George R. L. Gaughran, anatomy. Muscle group forces at joints.

Volney H. Jones, Museum of Anthropology. Preparation of a compendium of data on economic botany of Indians of the Southwest.

George H. Lauff, zoology. Primary production of organic matter in an aquatic environment.

Clifford R. Noll, Jr., biological chemistry. Study of the organic acid and amino acid composition of plants.

Frederick K. Sparrow, botany. Revision of "Aquatic Phycomyces."

Lewis E. Wehmeyer, botany. Perithecial development in the pyrenomycetous fungi.

Richard K. Beardsley, anthropology. Study of the rural foundations of Japan.

Daniel Katz, psychology. Comparative effect of two methods of changing attitudes upon people who vary in ego defensiveness.

George Kish, geography. Regional political geography of Italy.

George Herman, speech. Quantitative study of recruitment of loudness in hearing loss.

Makepeace U. Tsao, biochemistry. Blood chemical study of uremia.

The University of Pittsburgh has received a \$500,000 grant from the Maurice and Laura Falk Foundation, Pittsburgh, for library facilities in the new \$15 million building for the Schools of the Health Professions. The recent gift is in addition to a previous grant of \$300,000 provided in 1949 by the Falk Foundation for a medical school library.

Donald B. Zilversmit, associate professor of physiology at the University of Tennessee Medical Units, has been awarded a \$5292 research grant by the Life

Insurance Medical Research Fund to continue studies on the mechanism that induces hardening of the arteries in rabbits.

Research grants to two universities have been announced by The Upjohn Co. The University of Pennsylvania received \$3000 for the support of a fellowship in the School of Veterinary Medicine, and the University of Cincinnati was awarded \$2500 to be used by the College of Medicine for a fellowship in the department of pharmacology.

## In the Laboratories

Arthur D. Little, Inc., has announced the opening of its Western Laboratories Division (formerly the Merrill Company) through which all ADL research and consulting services are now directly available to West Coast industry. Charles G. Harford is technical director and Raymond E. Byler is business manager of the new division at 114 Sansome St., San Francisco 4, Calif.

After a year of intensive technical investigation, Aug. Schnackenberg & Co., Germany's leading producer of lead chemical equipment, and Knapp Mills, Inc., of New York, large producer of Ferrolum lead-clad steel and Cupralum lead-clad copper, have concluded an 18-yr license agreement whereby the German firm employs Knapp's patented processes and methods for the production of lead-clad metals in Germany.

Cellophane is wrenched and twisted, frozen and fried, sealed, folded, glued and printed—in fact, put to every conceivable test in the newly modernized Technical Service Laboratory by Sylvania Division, American Viscose Corporation. Working under the direction of John D. Conti, technicians have developed new equipment that successfully duplicates almost every field condition under which the material is used.

Ground has been broken at Allegheny General Hospital for a new wing to house Pittsburgh's first cobalt beam therapy unit and additional facilities for the hospital's department of radiology.

Location of a new cotton ginning branch laboratory at Clemson, S.C., for cooperative research with the state agricultural experiment stations and ginners in the Southeast has been announced by the U.S. Department of Agriculture. Establishment of this new facility, strongly endorsed and supported by ginners and various agencies in the cotton industry for several years, was provided for in the 1955 Agricultural Appropriation Bill in the amount of \$100,000.

The Du Pont Co. has announced acquisition of options on land in California looking forward to the possibility of construction of a plant for the manufacture of tetraethyl lead and Freon refrigerants. Tetraethyl

lead and Freon refrigerants are needed in increasing amounts to meet the requirements of the huge petroleum industry and the rapidly developing refrigeration and aerosol industries on the West Coast.

The General Electric Research Laboratory, Schenectady, N.Y., will produce a new alloy capable of withstanding higher temperatures than any wrought alloy now commercially available. G.E. is particularly interested in providing new materials for the better performance of jet engines, rocket motors, gas turbines, and other devices operating at high temperatures. The initial output of the new alloy will be from an experimental vacuum furnace of 400-lb capacity. The pilot plant operation is expected to grow rapidly as a result of the company's metallurgical pioneering. This fall the section devoted to such researches will move into a new \$3,000,000 laboratory structure, nearly doubling present facilities and staff.

Vitro Corp. of America has transferred its engineering and development activities being conducted at the Air Force Armament Center, Elgin Air Force Base, Fla., from its Engineering Division to the Laboratories Division, effective 1 July.

## Miscellaneous

Volume 4 of *Arctic Bibliography* was published 20 Aug. by the Government Printing Office. It deals largely with the human being in his relationship to the northern environment. The first three volumes of this work, which were released in Aug. 1953, are concerned with the literature of the earth sciences and biological sciences generally. The new volume, however, emphasizes publications in the fields of medicine, public health, housing, sanitation, and water supply. Native peoples, especially those of northern Eurasia, and the various adaptive measures they have developed also receive particular attention. Articles in English, Russian, German, the Scandinavian, and other languages are abstracted, but emphasis is given to writings from northern Scandinavia and Finland, regions where an arctic economy has been operating successfully for some time.

*Arctic Bibliography* was compiled by the Arctic Institute of North America under a contract with the Office of Naval Research and with funds provided by the Army, Navy, and Air Force. The editor, Marie Tremaine, is known for her previous work in Canadiana. Compilation of the *Bibliography* has been under the direction of a steering committee headed by Henry B. Collins, anthropologist of the Bureau of American Ethnology, Smithsonian Institution, and a member of the board of governors of the Arctic Institute.

The Centro de Documentación Científica y Técnica de México, a nonprofit organization jointly created by UNESCO and the Mexican Government, has been

functioning since its establishment in 1951 as a regional center, its services being available to all Latin American countries. UNESCO terminated its assistance in February 1954, and the center has been run ever since by the Mexican Government "for the collection of the scientific and technical documentation produced in the different countries of the world, to make it be known and distributed in the universities, in the technical institutes, and in the professional schools and in the laboratories of scientific and industrial research, being at the same time a center of coordination of the libraries."

The center now receives some 2000 journals, and the number is increasing by 30 or 40 monthly. From this material a monthly bibliographic bulletin is compiled. For each article contained in the journals the bulletin gives the title translated into Spanish, followed by the title in the original language and the bibliographic reference. In the case of Latin-American articles, an abstract in English or French is provided. The bulletin, which is widely distributed through subscription and exchange, is divided by subjects into more than 130 sections and subsections.

Another activity of the center is the compiling of bibliographies on particular subjects. In addition, translations of scientific or technical papers are made from any language into Spanish, and courses in technical English, German, and French also are given. The center's address is Plaza de la Ciudadela 6, Mexico 1, D. F.

The New York State Department of Civil Service, 39 Columbia St., Albany 7, has announced an examination for assistant hydraulic engineer. Applications will be accepted until 24 Sept.

The U.S. Geological Survey is releasing in open files the following maps and reports on the geology of parts of the United States. Copies, available for consultation at the Geological Survey, Room 1033 (Library), General Services Administration Building, Washington, D.C., are: Current velocities in Sagadahoc Bay, Maine; high alumina metamorphic rocks of the Kings Mountain district, N.C. and S.C.; copper and uranium mineralization in the Coyote mining district, Mora County, N.Mex.; geology of an area about Yankton, S.Dak.; geologic map of La Sal Mountains, Utah; and geologic map of Morgantown quadrangle, N.C.

The Government Patents Board has announced publication of *Instrumentation*, a volume that lists and briefly describes 775 Government-owned inventions in the field of instrumentation. The listings are classified into eight subgroups: Laboratory, scientific and engineering instruments; instruments for indicating, measuring, and recording electrical quantities and characteristics; mechanical measuring and controlling instruments; optical instruments and lenses; surgical and medical instruments; x-ray and therapeutic apparatus, surgical and orthopedic appliances and supplies; photographic equipment and supplies. Also

listed are the addresses of the various field offices of the U.S. Department of Commerce and of the Small Business Administration; they may be consulted concerning the availability and use of these inventions. The volume on instrumentation may be purchased from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

This volume is the first of a series of seven on Government-owned inventions scheduled for publication this year under the joint sponsorship of the U.S. Department of Commerce and the Small Business Administration. The titles of the other six books, with the number of inventions briefly described in them are *Chemical Products and Processes* (1349); *Food Products and Processes* (265); *Metal Products and Processes*, *Machinery and Transportation Equipment* (658); *Electrical Apparatus*, including *Electronics* (1920); *Ceramic, Paper, Rubber, Textile, Wood and Other Products and Processes* (308); and *Ordinance* (647).

Organizations accepted for membership in the Radio Technical Commission for Aeronautics are Northeast Airlines, Slick Airways, Inc., Westrex Corporation, and Decca Navigator System, Inc. RTCA, a cooperative association of government and industrial aeronautical agencies, has as its primary objective the resolution of aeronautical telecommunications problems in a manner acceptable to all phases of aviation. Its recommendations have had wide acceptance. Membership in RTCA is open to any U.S. organization actively identified with some phase of aeronautical telecommunications.

Reasons for the acceptance of scientific theories is the central theme of the following four papers in the September issue of *The Scientific Monthly*: "The variety of reasons for the acceptance of scientific theories," by Phillip G. Frank; "Influence of political creeds on the acceptance of theories," by Barrington Moore, Jr.; "Notes on a pragmatic theory of induction," by C. West Churchman; and "Remarks on value judgments in scientific validation," by Richard Rudner. These papers comprised the first of five sessions held in Boston, 27-30 Dec., on the general subject *Validation of scientific theories*. The remaining papers of the series will appear in subsequent issues.

Other articles featured in *The Scientific Monthly* for September are: "International cooperation to improve world agriculture," Ralph W. Phillips; "The trouble with science courses," Bruce Stewart; "Signals through space," William L. Roberts; "Agriculture versus chemistry in the nutrition of man," D. M. Hegsted and Frederiek J. Stare; "Bibliographies of eminent scientists," Wayne Dennis; "Stripping the sea of her secrets," a pictorial account of Britain's Hydrographic Department of the Royal Navy. The paper by Hegsted and Stare was presented at the Boston meeting of the AAAS as a part of the symposium *Species that feed mankind*. Other papers from this symposium will appear in issues to follow.

A supplement to the S.L.A. List of Translations, October 1953, that lists nearly 700 additional titles, may be obtained for \$1 per copy from the Special Libraries Association Translation Pool, John Crerar Library, 86 E. Randolph St., Chicago 1. Under contract with the Special Libraries Association, The John Crerar Library now maintains and services the Translation Pool. At the present time approximately 2000 translations from all languages except Russian are on file.

The Biology Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn., has announced that copies of its monograph, "Symposium on effects of radiation and other deleterious agents on embryonic development," are available gratis to scientific investigators who can establish a need for this publication.

This month the Worcester Foundation for Experimental Biology conducts its annual "Heroes of Science" stamp campaign to raise funds in support of its nonprofit research. The foundation operates without endowment and makes its findings available to the public. It is a local institute which, thanks entirely to research and philanthropic grants and the generosity of the public, has grown from a humble beginning in the basement and later a barn at Clark University to a staff of 120 with its own permanent laboratories at Shrewsbury, Mass. Research grants come from such sources as the American Cancer Society, the U.S. Army, Navy, and Air Force, the U.S. Public Health Service, the Atomic Energy Commission, and the Rockefeller Foundation.

## Necrology

Hugo Eckener, 86, dirigible pioneer, Friedrichshafen, Germany, 14 Aug.; Joseph W. Gartland, 53, research chemist for the National Carbon Company, Cleveland, Ohio, 15 Aug.; Laurence P. Geer, 62, head of the chemistry department at the University of Tampa, Tampa, Fla., 11 Aug.; Isaac H. Godlove, 62, leader in the field of color, author, editor, and senior physicist for the General Aniline and Film Corp., Easton, Pa., 14 Aug.; Ernest E. Hadley, 60, author, editor, director of the Washington Psychoanalytic Institute, and former director of the Washington School of Psychiatry, Washington, D.C., 10 Aug.; Bryn J. Hovde, 58, former president of the New School of Social Research in New York and executive director of the Pittsburgh Housing Association, Pittsburgh, Pa., 10 Aug.; Einar Key, 81, former president of the Swedish Academy of Science, editor, and retired professor of surgery at the Caroline Institute, Stockholm, Sweden, 11 Aug.; Floyd L. Nutting, 68, professor of physics at the Drexel Institute of Technology, Philadelphia, Pa., 7 Aug.; Arthur Sowerby, 69, naturalist, author, and authority on the Far East, Washington, D.C., 16 Aug.; Lansing S. Wells, 62, chemist with the National Bureau of Standards, Washington, D. C., 8 Aug.

## Book Reviews

*Proceedings of a Conference on the Utilization of Scientific and Professional Manpower.* Columbia Univ. Press, New York, 1954. xii + 197 pp. \$3.50.

The conference program summarized in this volume was sponsored by the National Manpower Council and Columbia University. Eli Ginzberg and Henry David, who planned the conference and edited the materials for publication, have been extremely skillful in carrying over into the text the atmosphere of discussion in the conference. The report is recommended for the interest of the controversial issues raised for discussion as well as for the practicality of its suggestions and findings.

Kenneth Boulding raised what was, perhaps, the most controversial issue, when he protested the delusive simplicity of the concept of "manpower," and claimed that it was appropriate only to a planned economy. He argued for considering "men in their infinite variety and sacredness," and of interfering only to "free the market to pursue its normal course." In the discussion that followed this paper, there was agreement that individuals and their incentives are the key to some manpower problems, but differences of opinion developed on the need for planning, on the role of professional societies and education, and on the influence of military policy.

The impression left by the other introductory papers, presented by James D. Zellerbach, Frank Pace, Jr., and Seymour L. Wolfbein, was that, for better or worse, administrators of educational and placement programs are faced with problems in the recruitment, training, and utilization of professional workers and have to do some planning in this context.

Then the conference got down to cases. That nurses and auxiliary medical workers and teachers are currently in short supply was generally accepted by conference participants. It was noted that many workers with the requisite training are lost to these professions because they leave for other kinds of jobs or, in the case of women, retire from the labor market. In this connection, the quality of students in training and incentives to remain in the teaching and nursing professions were of considerable interest to working groups in the conference.

Numerous instances of "skill dilution" through the substitution of the services of persons with less training for the performance of some functions were noted, particularly in engineering and medicine. Among the recommendations to increase the productivity of professional workers were modifications of the equipment and construction of schools and hospitals, development of new work patterns such as the "team approach," improved leadership and administration, and continuing reappraisal of the appropriateness of training programs.

GLADYS L. PALMER

Wharton School, University of Pennsylvania

*Introduction to Aeronautical Dynamics.* Manfred Rauscher. Wiley, New York; Chapman & Hall, London, 1953. xiv + 664 pp. Illus. \$12.

This textbook is the culmination of the author's teaching of a special course in dynamics over a period of 20 years. The course is focused on the needs of third-year undergraduate students in aeronautical engineering for a thorough grounding in the principles of the dynamics of particles, dynamics of rigid and elastic bodies, and dynamics of fluids, preparatory to the study of the theory of the dynamic stability of aircraft in the following year.

The chapters of the book are readily separated into two groups, one covering topics in solid dynamics, the other topics in fluid dynamics. The arrangement of chapters is determined by the teaching plan for related courses, particularly that in applied aerodynamics. Thus the sequence is particle dynamics, fluid dynamics, rigid bodies, and oscillations.

Throughout the book fundamental principles are emphasized, but aeronautical applications are introduced when they are appropriate. With a few exceptions, each chapter ends with a list of problems that illustrate the principles, usually by an aeronautical application. An excellent treatment is given the problem of the motion of a particle of variable mass with application to rocket propulsion, a subject that is very confusing to those who have forgotten the accurate statement of the energy and momentum principles.

The topics in fluid mechanics are indicated by the chapter headings: "Fundamental equations of fluid motion," "Stream function and velocity potential," "Fluid motion about simple bodies," "Transformations," "Airfoils," "Airfoils in three dimensions," "Viscosity." Discussions of compressible flow are limited to one-dimensional problems, incompressible flow to two-dimensional problems, including the theory of airfoils of finite span, which is of course an adaptation of two-dimensional theory.

The final chapters deal with the kinematics of rigid bodies, the concepts of momental ellipsoid and principal axes, precessional and nutational motions, and oscillations with one and two degrees of freedom.

HUGH L. DRYDEN

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*Scientific and Technical Papers.* Seinen Yokota. Compiled and published by the Yokota Memorial Committee, Univ. of Tokyo, Tokyo, Japan, 1954. xx + 398 pp. + 137 tables. Illus.

This memorial publication of the late Seinen Yokota, professor emeritus of the University of Tokyo, contains a biographical sketch as well as 46 scientific and technical papers, most of which were written in English. Although his special fields were



naval architecture and aeronautical engineering, he was interested in various other fields, such as ballistics, elasticity theory of vibration, mathematics, and the methods of practical calculation.

Among his papers, the following ones seem to be most important for acquainting a reader with his ability.

"On the vibration of steamers" (1906), his doctoral thesis, consists of elegant theoretical analysis, including the most original practical device of solving the fundamental equations using two integrals at the same time. "Motion of a projectile in a resisting medium" (1910) is an article on ballistics in which Yokota showed his beautiful accomplishments in mathematical analysis, especially of elliptic functions. "General expression for stress components in two dimensional problems of elasticity" (1914) is perhaps one of the severest mathematical papers ever put before a Japanese society of engineers up to that time. In "Theoretical consideration of water waves" (1918), he showed that the sea wave was the Stoke's wave rather than the trochoidal wave. "Action of *Ro*" (1926) is a treatment of the hydrodynamical aspects of the propelling and steering devices of the Japanese boat. "Pressure distribution over the surface of a ship" (1925) is a valuable and exhaustive investigation on ship resistance. The proposal given in "Discontinuous flow past an aerofoil" (1926) must be regarded as the first forerunner of the modern tendency to search for aerofoils with small resistance by means of making the pressure distribution uniform over the upper wing surface along the chord.

Seinen Yokota's invaluable services to engineering education in Japan lasted for about 40 years of his residence at the University of Tokyo. The present experts in naval architecture and aeronautical engineers in Japan have been educated by him, directly or indirectly.

This is a valuable reference concerning naval architecture in the later Meiji and Taisho era and the origin of aeronautical engineering in Japan.

TOKUO SUITA

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**Sweet Corn.** Walter A. Huelsen. Interscience, New York-London, 1954. xv + 409 pp. Illus. \$10.50.

This book is intended to be a comprehensive work on sweet corn, covering the growing, breeding, history, and processing of this important vegetable. The author's knowledge of the corn-processing industry is reflected in a very complete coverage of all phases of the canning industry. More than one-third of the book is devoted to the processing of sweet corn, either by canning or freezing.

For those interested in processing sweet corn, this is an important book. It is unfortunate that it does not include a chapter or two on growing corn for the fresh-corn market, either by the market or home gardener. Recent trends on rapid handling to preserve

original quality could well have been given. Also, the chilling of picked corn to preserve quality could have been covered, and I believe that more emphasis should have been placed on breeding for improved quality.

The book is encyclopedic in nature, covering a wide variety of subjects. This is a strong point but also a weakness, in that all points covered receive about the same emphasis or lack of emphasis. It will be useful as a reference for those already rather familiar with the subject, which is probably its intended purpose.

In general, *Sweet Corn* is well organized, although it is difficult to see the reason for the separation of Chapters V and VI on "Factors affecting germination" and "Physiology of germination, growth, and maturity." Also, the chapter on "Mineral nutrition" might well have been included in the chapter on "The plant and its environment."

The author has covered concisely and accurately the history of sweet corn, including the history of the first corn hybrids and the relative importance of the contributions of both East and Shull to this undertaking. The history of the sweet-corn hybrids for market corn is rather sketchily presented. The chapter on taxonomy and morphology is an interesting one that should be included in any comprehensive work on sweet corn. It is doubtful how much the average reader will gain from this chapter, but at least he should be exposed to it.

Huelsen has attempted a complete coverage of the literature on sweet corn and of the pertinent literature on field corn. In fact, he states that "It is doubtful whether anything of significance has escaped [his] attention." This is a bold statement! I found at least two omissions, one major and one minor. The first, and major, omission is a rather comprehensive bulletin entitled *Sweet Corn Hybrids* [Conn. Bull. 518 (1948)], which is concerned mainly with market garden sweet-corn hybrids; the second, and minor, omission, a reference to the work of Noyes Darling, the first sweet-corn breeder in *The Journal of Heredity* (1944).

I observed a few statements with which I take exception, such as "The objective of W. J. Beal was not to induce hybrid vigor by means of crossing." I went into the work of Beal rather thoroughly, and it is clear that he planned crossing experiments for the sole purpose of testing increased yields of hybrids. Also, most geneticists would not agree that such genes as *bt<sub>1</sub>*, *bt<sub>2</sub>*, *bt<sub>3</sub>*, and *sh* would be classed as types of female sterility. Also, the statement that "a pure line produced fluctuations just as extreme as heterozygous lines" reflects a rather prevalent attitude but one that does not bear close scrutiny, since the "pure line" may be extremely heterozygous for factors that are not visible externally and for which there has been no selection during the inbreeding process.

The growers of sweet corn, especially those concerned with sweet-corn processing, will find *Sweet Corn* an interesting and useful book.

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*Methods of Biochemical Analysis*. vol. I. David Glick, Ed. Interscience, New York, 1954. x + 521 pp. Illus. \$9.50.

There are few research areas in biochemistry that do not have their own special experimental procedures. Indeed, it has been necessary, in many cases, that the development of adequate methods precede other significant advances. Hence, in the last decade or so, biochemistry has been characterized by the development of many new and versatile research tools. In turn, the value of these has been well demonstrated during the consequent marked evolution of biochemical knowledge. As Glick points out in the preface, with respect to the latter phase of this sequence of events, "Annual review volumes . . . have proved their value repeatedly and are now widely used and well established." It follows that biochemists will welcome the appearance of the first review designed to keep them familiar with the ever-increasing number of new methods as well as with new refinements and applications of older methods.

Two aspects of *Methods of Biochemical Analysis* are worthy of particular note. The first is the variety of methods discussed. Many of them are amenable to much wider application than is implied by the use of the word *analysis* in the title. The methods discussed in chapters entitled "Zone electrophoresis," "Chromatographic separations of steroids of the adrenal gland," and "Ultracentrifugal analysis of serum lipoproteins," to cite only a few examples, are appropriately described as analytic only in the broadest, and perhaps not the usual, sense of the word. The second notable aspect is a feature rather unique to the review under discussion. More typical review arrangement would have included the subject matter of the last two chapter titles in broader discussions of chromatography (or at least chromatography of steroids) and ultracentrifugal analysis. In fact, "Zone electrophoresis" is the only chapter title that mentions the method discussed without further restricting it to a particular type of compound, and in many cases chapter titles are further restricted to compounds of a given source, as illustrated at the beginning of this paragraph. Other examples of this use of very restrictive chapter titles are "Determination of sulfhydryl groups in certain biological substances," "Microbiological assay of vitamin B<sub>12</sub>," "Analysis of mixtures of sugars by paper and cellulose column chromatography," and "Chromatographic analysis of radioactive iodine compounds from the thyroid gland and body fluids."

The first impression that results from these aspects of the review is that it would be more appropriately entitled "Biochemical Methods" and that the chapter titles should be a little more general. There is, however, a favorable consequence of this new approach that may well outweigh its disadvantages. This is illustrated in the introduction of the chapter entitled "Analysis of phenolic compounds of interest in metabolism." Here it is explicitly stated that "Only those methods with which the authors have had personal

experience have been described in detail." The editor's choice or acceptance, as the case may be, of relatively restricted topics for review permits the authors to write from firsthand experience. This makes for short, clear, and concise chapters and allows the inclusion of valuable and reliable experimental details.

W. H. TALLENT

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*Biochemistry and Physiology of Nutrition*. vols. I and II. Geoffrey H. Bourne and George W. Kidder, Eds. Academic Press, New York, 1953. vol. I, xiii + 569 pp. Illus. \$13. vol. II, xi + 641 pp. Illus. \$15.

This concise treatise was written by 14 British, Scottish, and Australian scientists and by 14 scientists living in the United States. All the authors and editors have made important research contributions in their fields of specialization. The two volumes are primarily concerned with the basic metabolic functions of animals because these "have assumed a definite and indispensable place in the science of nutrition." There are 23 chapters, and approximately nine of them are essentially in the category of fundamental biochemistry. Substantially all of the others follow the usual nutritional pattern for discussions of dietary essentials and factors affecting their utilization, but in many of these chapters there is also emphasis on the roles of food components in metabolic reactions.

The major topics include a review of the early history of nutrition, history of vitamins, water and electrolyte metabolism, biochemistry of amino acids, carbohydrate metabolism, lipid metabolism, biosynthesis of protein, concise review of fat-soluble vitamins, vitamin-B complex, vitamin C, vitamins and hematopoiesis, structural changes in vitamin deficiency, microbiology of the alimentary tract, nutrition of invertebrate animals, biological oxidations, extensive discussions of enzymes and coenzymes, and brief reviews of iron metabolism and of calcium and phosphorus metabolism. There is a comprehensive chapter on trace inorganic elements. The treatise is concluded with a chapter of 75 pages on "Application to human nutrition," written by Grace A. Goldsmith. The "biochemistry" and the "nutrition" are about equally divided in each of the two volumes.

The editors assert that the authors were allowed a large measure of independence in the development of their chapters. This is evident in the considerable repetition of subject matter and in the fact that many relevant topics either were not included or were treated with undue brevity. For example, there is no reference to relationships between nutrition and cataracts of the eyes except for brief mention of cataracts referable to riboflavin deficiency or resulting from the administration of ascorbione. Although there are many papers on the relationships between fat utilization and melting point, length of the fatty-acid chains, and so forth, this subject is not mentioned. Nevertheless, the two

volumes contain a great wealth of valuable information for all categories of nutritionists and especially for those who are concerned with enzymology and intermediary metabolism. The discussions are extensively documented with tables, figures, and references to the literature. In general, the writing is clear, readable, and remarkably free from errors. The organization and format are good. All students of the science of nutrition in its many aspects will find the treatise of much value.

HARRY G. DAY

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**Dvorine Pseudo-Isochromatic Plates.** Israel Dvorine.

Israel Dvorine, 2328 Eutaw Place, Baltimore, Md., ed. 2, 1953. \$12.

This is a conventional type of color-vision test, identical in principle and similar in appearance to earlier pseudo-isochromatic plate tests, such as those of Stilling, Ishihara, and the American Optical Company. By way of explanation, it may be noted that a pseudo-isochromatic plate is a figure and ground composed of many small disks or dots of irregularly varied color and size; ideally, there is enough hue difference between the figure and ground to permit the color normal to distinguish the figure but not enough for the color blind.

The Dvorine test plates are assembled in a six-ring binder between hard covers about 7 in. square. The first section contains 15 number plates, including a demonstration plate with a number anyone can read. The second section, headed "Alternate testing plates," contains eight trial plates in which the figure to be identified is not a number but rather an irregular path to be traced by the testee. The sections of plates are preceded by instructions regarding illumination and administration and a sample score sheet. Incorrect responses to three or more plates of the first section or to two or more plates of the second section are said to indicate defective color vision.

An advantageous detail that is not found in most tests of this type is the loose-leaf binder, which permits rearrangement of the plates to baffle malingerers. The similarity of the dot patterns on all plates is designed to provide another stumbling block for the unscrupulous. Such devices augment the difficulty of responding to secondary criterions rather than to the test figures themselves. On the other hand, the Dvorine test lacks a valuable diagnostic feature of the Ishihara test, namely, the double identification plate. Such a plate is difficult to produce, but it affords the double check of presenting different figures that are readable, respectively, by persons with normal color vision and those with abnormal color vision.

The Dvorine test is similar to the new edition of the Ishihara test in respect to an especially important limitation—there remains to be published validation data to demonstrate whether or not, or how well, the test does detect defective color vision. In view of this limitation, several of the deviser's representations

cannot be accepted, at least at the present time. They include the assertions that this is the most sensitive test yet devised for red-green color blindness, that certain specific critical scores (mentioned earlier) separate the normals from the color weak, and that as few as two or three plates suffice to diagnose specific protanoid and deutanoid types.

A review of a test can scarcely be of value to readers interested in using tests unless it provides some indication of validity. Therefore, I sought to secure, by reference to a few unpublished data, some advance idea of what a proper validation of this test might eventually reveal. Number-plates tests of 47 color-deficient and 16 normal subjects (most of which were made by Louise Sloan and others at Eastman Kodak Company) seem to indicate that the Dvorine test compares quite favorably with better tests of this type. There was only a single case of misclassification and this particular case also had given trouble in other plate tests.

The relationships between the first and second editions are not without interest. The present edition includes four plates that, to persons with normal vision, appear to be essentially identical to the plates in the first edition. All the present plates, however, are said to be new printings. A more significant point, perhaps, is the fact that the first edition was associated with an abortive effort to improve color vision by training, whereas the present edition is presented simply as a test of color vision without any claim to a special capacity to modify the testee's status. As such, it may well prove to be a satisfactory screening test.

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**Sea-Birds.** An introduction to the natural history of the sea-birds of the North Atlantic. James Fisher and R. M. Lockley. Houghton Mifflin, Boston, 1954. xvi + 320 pp. Illus. + plates. \$6.

This is a review of the sea-birds that nest on the shores of the North Atlantic from the Arctic Ocean to the equator, with special reference to their habits and place in nature. All must lay their eggs on land, and many do so in spectacularly crowded colonies at some favorable spot. The characters of at least their major nesting stations on the circumference of the North Atlantic, and the species pertaining to each, are considered, with somewhat greater emphasis on the northeast quadrant of the ocean, which is presumably most familiar to the authors.

A chapter on "Sea-birds, numbers and man" shows that man is their greatest enemy and introduces data on which the conservation of sea-birds may well be based. A companion chapter on "What controls the numbers of sea-birds?" sets forth the argument that food supply is the chief factor, and it undoubtedly is an obvious and very important factor and states that species, however closely related, when successful

in the same area, do not compete directly in food and feeding habits.

*Sea-Birds* is disappointing as a reference work. Related items of data are inextricably scattered throughout the book, and after reading them once, I found that the index, which is systematic and not alphabetical, was of little help in finding the items again. Both the vernacular (more or less local) nomenclature and the technical (apparently up-to-date) nomenclature are used confusingly and without explanation. Without previous knowledge of the subject, it would sometimes be difficult to know exactly which bird is being referred to.

However, it is a book that should stimulate interest and be enjoyed by any bird-minded reader to whom sea-birds are relatively little known. Its appeal is enhanced by many excellent portrait photographs of the diverse species and of their colonies. Furthermore, in browsing through its pages, a serious student of sea-birds can hardly fail to find data and ideas of value, especially where these are firsthand and not gleaned from the literature.

J. T. NICHOLS

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**The Structure of Metals and Alloys.** Wilhelm Hume-Rothery and G. V. Raynor. Monogr. and Rept. Ser. No. 1, Institute of Metals, London, ed. 3, 1954. viii + 363 pp. Illus. + plates. \$5.50.

This is really a new book, although it is called the third edition of Hume-Rothery's book, which was first published in 1936 as a brief book of some 120 pages (second edition in 1944). Hume-Rothery and Raynor are now the authors, and the text is about 3 times the size of the second edition. Whereas the first edition was addressed both to the research man and the practical metallurgist, the new edition is a survey of the modern approach to metallurgy, and as such it should help the practicing metallurgist to understand the electronic background and its consequences.

A brief chapter on the structure of the elements is followed by a chapter on atomic radii and some physical properties of the elements, these chapters are followed by some 70 pages on primary metallic solid solutions and some 40 pages on intermediate phases and alloy systems. Part 6 (some 50 pages) "The structure of the alloys of iron" is entirely new, and the last part, "Imperfections in crystals and deviations from the ideal lattice," has been considerably enlarged and brought up to date to give the main ideas of the theory of dislocations and their applications.

Both authors are well known, not only for their scientific research in the field, but also for their success in bringing the background of modern physics to the attention of the practicing metallurgist. An introduction to the *Electron Theory of Metals* by Raynor is Monograph No. 4 of this series, and Hume-Rothery has contributed in Monograph No. 3, *The Atomic Theory for Students of Metallurgy*. In 1948, Hume-Rothery also published, in the form of a dialogue, a

discussion of the modern approach to metallurgy, entitled "Electrons, atoms, metals, and alloys." I am mentioning these monographs by Raynor and Hume-Rothery because I feel that the study of the present book would gain considerably if some of the background available in the other two books were available to the reader. I do not think that the mathematics that is used in the others is such that the practicing metallurgist would be frightened away, and it would help considerably in understanding the large amount of material that has been put together in this new work, which is entirely nonmathematical and more or less descriptive.

Therefore, it might be well to recall the cautious advice from the preface of Raynor's *Electron Theory of Metals*.

The reader will not finish this monograph, therefore, with the feeling that he can immediately do research in metal physics. Nor will he necessarily be able to understand, without assistance or interpretation, probable future advances. He will, it is hoped, be more at ease with some of the more modern ideas, and the way they are being applied. He should have some idea of what has been achieved by their use in metallurgy, and in what directions future progress is likely.

The amount of material is so large and the number of references is so extensive that it should be possible for the reader to find out about almost any of the modern concepts that are of importance in present-day metallurgy. The book can be recommended for the physicist who wants to understand the problems of the metallurgist and the metallurgist who wants to become acquainted with the approach of modern physics to his problem.

KARL LARK-HOROVITZ

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**Linear Operators.** Richard G. Cooke. Macmillan, London; St Martin's Press, New York, 1953. 454 pp. \$10.

The theory of discrete and continuous eigenvalue expansions associated with Hermitian linear operators in Hilbert space has long been recognized as one of the mathematical disciplines fundamental to quantum mechanics. Five of the seven chapters of Cooke's book are devoted to an exposition of this important mathematical theory; the remaining two chapters contain brief discussions of various related topics.

Chapter 2 gives a somewhat hurried statement of the physical applications of the pure mathematics of the remainder of the book, treating several standard problems (harmonic oscillator, perturbation theory, anharmonic oscillator) from both the Heisenberg and the Schrödinger points of view, and giving a more careful description of the continuous spectrum than is ordinarily found in "physical" analyses.

Aside from Chapter 2, the first part of the book is organized around Chapters 4 and 5 and around the idea of giving a large number of different proofs of

the central Hilbert-von Neumann spectral resolution theorem. Proofs due to von Neumann, Lengyel, Cooper, Riesz and Lorch, and Lengyel and Stone are given explicitly, and a number of other proofs are sketched briefly. The relationships between the various methods of proof are discussed.

Chapter 6, in many ways the most unusual in the book, deals with the theory of matrix rings, extending the line of thought initiated in the author's earlier *Infinite Matrices and Sequence Spaces*. Chapter 7 takes up the Gelfand theory of commutative Banach algebras and develops this theory up to the point where a proof of the famous Wiener Tauberian theorem can be given. Finally, an extensive bibliography is given.

The text demands of the reader both a high level of general "mathematical maturity" and a fair working knowledge of the theory of functions of a real variable.

The principal drawback to this book is its somewhat disorganized character. For example, Chapter 6 is unrelated to any of the other chapters and constitutes, in essence, an appendix to *Infinite Matrices and Sequence Spaces*. Chapter 7 is independent of the preceding chapters; and although the methods developed in Chapter 7 could be used to give one of the most interesting proofs of the spectral resolution theorem in just a few additional pages, this is not done. The exposition throughout has the staccato character of lecture notes rather than the polished style customary in textbooks. It is my opinion that readers who are not interested in comparing a multiplicity of proofs of the spectral resolution theorem will find the recently published work of Riesz and Nagy more satisfactory.

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**Dimensional Methods and Their Applications.** C. M. Focken. St Martin's Press, New York; Edward Arnold, London, 1953. viii + 224 pp. \$6.

The chief purpose of this book is to show the practical value of the use of dimensional analysis in solving problems of science and engineering.

In Chapter I, the author distinguishes between fundamental magnitudes as those that are arbitrarily defined, such as length, mass, and time, on the one hand, and derived magnitudes, such as Young's Modulus, on the other hand. He gives the basic rules for the conversion of units from one system to another.

In Chapter II, the "complete equation" is defined as one that remains true or invariable when the size of the fundamental units is changed. The general principles of dimensional analysis are defined. The pi theorem is stated and applications are given. This useful tool states that if there are  $n$  quantities, either physical magnitudes or experimental constants, such that one and only one complete equation holds among them, and if among these there are  $m$  fundamental magnitudes, the relationship among the  $n$  quantities may be expressed as a function of  $n-m$  independent dimensionless products of the original quantities. Numerous

applications of this theorem and a general procedure for applying it to dimensional analysis due to Buckingham are given. O'Rahilly's measure ratio method for converting from one system of units to another is described.

In Chapter III, the questions of the dimensions of directed magnitudes and tensors of any rank are discussed. The problem of thermal magnitudes, requiring the introduction of a fundamental unit—for example, temperature or entropy—is discussed. Electric and magnetic magnitudes are described, with several suggested procedures for handling them, including the ideas of Maxwell and some more modern views.

In Chapter IV numerous applications to physical problems are described, including such modern devices as the chain-reacting pile (very briefly mentioned). Chapter V includes application to engineering phenomena and a description of model experiments.

The book contains numerous references to other workers in the field, including particularly P. W. Bridgman, E. Buckingham, H. Dingle, and Lord Rayleigh. It provides a more critical look into the problem of dimensions than the average scientist or engineer has given. The tables of dimensions—for example, of electromagnetic quantities in various systems—are useful. Some ideas on the design of experiments are suggested.

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**Optical Instrumentation.** George S. Monk and W. H. McCorkle, Eds. McGraw-Hill, New York-London, 1954. xxv + 262 pp. Illus. \$3.75.

This is the eighth volume of the Plutonium Project Record of the "National Nuclear Energy Series." It contains a summary of the work carried out during World War II by members of the Optics Section of the Metallurgical Laboratory at the University of Chicago. This section, which started work in the fall of 1943 and was in existence for 2 years, was entrusted with the design and construction of optical equipment for remote control in irradiated areas. It also carried out research on the influence of high-energy radiation on optical materials and on the design of achromatic lenses consisting of materials that were found to be most resistant to destructive radiation.

The volume consists of two parts. The first part, entitled "A survey of optical and associated problems," makes the reader familiar with the peculiar optical problems encountered, discusses in general the possible ways of solution, and gives an over-all picture of the achievements made. The third chapter of this part is devoted to miscellaneous instruments and to investigations in connection with the project, and it also gives an account of work that was done on the production of thin films by evaporation and sputtering in vacuum. Two tables containing valuable data regarding a great number of deposited films deserve



special mention. The production of low-reflection coatings is also briefly discussed, since they are of great importance for the reduction of light losses in all instruments composed of a great number of single-refracting elements—for example, periscopes and borescopes.

The second part of the volume is a collection of 37 papers based on the periodical reports of the Optics Section. These papers give detailed information on topics treated summarily in the first part. Of special interest are the papers by G. S. Monk on the coloration of optical materials by the radiation of a reactor as well as several papers concerning the application of plastic high-quality lenses.

The discussion of the optical details is kept so simple that a modest knowledge of geometrical optics is sufficient. The book is of great value for general and special information on optical instrumentation in nuclear research. It may also serve as a textbook for special courses in this field. In keeping with the nature of the book, developments during recent years have not been included. However, an appendix to part I of up-to-date references regarding the achievements made elsewhere since 1945 would have been of great value.

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**Scintillation Counters.** J. B. Birks, McGraw-Hill, New York; Pergamon Press, London, 1953. 148 pp. Illus. + plates. \$4.50.

The fact that individual photons and nuclear particles can effect a short light flash in many luminescent materials has led to the recent development and wide application of the scintillation counter as an important instrument for the detection and measurement of these radiations. J. B. Birks' book, which is one of a series of monographs on current research in electronics and applied physics, is a critical review of the development of this instrument through 1953 and a clearly presented description and analysis of its components, techniques, and applications.

The book begins with a short historical introduction that illustrates how the remarkable versatility of the scintillation counter was achieved as a result of the relatively recent development of the high-gain photomultiplier tube and the discovery of a variety of new phosphors. The second chapter specifies the combination of components of the modern scintillation counter and describes the basic processes involved in its operation. Detection efficiency is obtained from a consideration of the interaction of ionizing particles and x- or gamma-ray quanta with the phosphor. A general formula is derived for the magnitude of the current pulse at the output of the photomultiplier caused by an

ionizing particle of a given energy. A useful contribution are formulas that incorporate an economy of parameters especially appropriate to the typical scintillation-counter arrangement. The third chapter is a discussion of the two main classes of photomultiplier tubes that have been found useful for scintillation counting. Some of the important characteristics are given for the commercially available types. Chapter 4 considers the problem of pulse height and time resolution, two of the most significant properties of the counter.

The major part of the monograph is an extensive summary and theoretical treatment of luminescent materials applicable to scintillation counting. The published theoretical and experimental work on the more important inorganic crystalline phosphors, such as zinc sulfide, the alkali halides, and the tungstates, is well covered. The author has provided a list of most of the inorganic materials reported to be phosphors, grouped according to their constituent elements.

Organic crystal, plastic, and solution phosphors are given an especially thorough treatment. These chapters include some of Birks' own contributions to the theory of luminescence and the scintillation process in organic phosphors. As the author points out, the luminescence of organic substances is an inherent molecular property, and therefore the mechanism differs fundamentally from that of inorganic crystals. His pertinent proposition is that the transition from the second or higher electronic state of an excited molecule is accompanied by the emission of ultra-fast, short wavelength fluorescence, which is strongly absorbed by a neighboring molecule. This process recurs, producing a "photon cascade," with very close to 100-percent quantum efficiency until the excess energy is dissipated thermally, when the final transition from the first electronic excited state to the ground state gives the normally observed fluorescence. A convincing argument is made for this mechanism on the ground that it allows a modification of the older theories such that the predicted fluorescence efficiency of an organic phosphor for incident short-range ionizing particles is in more satisfactory agreement with experimental data.

The concluding chapter is a survey of the applications of the photomultiplier scintillation counter to date. These applications include the detection and energy measurement of x- and gamma-radiation, electrons and heavy particles, and slow and fast neutrons. A description is given of the apparatus and techniques for the study of mesons, positrons, and short-lived nuclear isomers. The book contains an adequate bibliography that gives the reader good access to the literature.

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## Books and Recordings Reviewed in THE SCIENTIFIC MONTHLY

### September

- The Challenge of Man's Future*, Harrison Brown (Viking Press). Reviewed by Harry C. Kelly.
- A History of the Theories of Aether and Electricity*, Sir Edmund Whittaker (Philosophical Library). Reviewed by Gerald Holton.
- Two Roads to Truth*, Edmund W. Sinnott (Viking Press). Reviewed by Bentley Glass.
- Europe and America since 1492*, Geoffrey Brunn and Henry Steele Commager (Houghton Mifflin). Reviewed by Mark M. Heald.
- Symbolic Logic*, Irving M. Copi (Macmillan). Reviewed by Albert A. Bennett.
- Dynamic and Abnormal Psychology*, W. S. Taylor (American Book). Reviewed by John F. Dashiell.
- An American in Europe*, Egon Larsen (Philosophical Library). Reviewed by Mina Rees.
- Curious Creatures*, Erna Pinner (Philosophical Library). Reviewed by Karl P. Schmidt.
- Sounds of the American Southwest*, (Folkways Records and Service Corp.). Reviewed by Karl P. Schmidt.
- The Mockingbird Sings* (Cornell Univ. Records). Reviewed by Karl P. Schmidt.
- Florida Bird Songs* (Comstock Publ. Associates).
- The Macmillan Wild Flower Book*, Clarence J. Hylander; illus. by Edith F. Johnston (Macmillan). Reviewed by Paul B. Sears.
- Die Botanische Buchillustration*, Claus Nissen (Hiersemann). Reviewed by A. C. Smith.
- Galathea's Jordomsejling 1950-1952*, A. F. Bruun *et al.*, Eds. (Schultz Forlag). Reviewed by Gustaf Arrhenius.
- Fundamentals of Reservoir Engineering*, John C. Calhoun, Jr. (Univ. of Oklahoma Press). Reviewed by George G. Lamb.
- High Altitude Rocket Research*, Homer E. Newell, Jr. (Academic Press). Reviewed by Kenichi Watanabe.
- The Sun*, Gerard P. Kuiper, Ed. (Univ. of Chicago Press). Reviewed by Bart J. Bok.

### New Books

- Biochemistry*, Abraham Cantarow and Bernard Schepartz. Saunders, Philadelphia-London, 1954. xxv + 848 pp. Illus. \$11.
- The Art and Antique Restorers' Handbook*, George Savage. Philosophical Library, New York, 1954. vi + 140 pp. \$4.75.
- W. H. Hudson*, Ruth Tomalin. Philosophical Library, New York, 1954. 143 pp. \$3.50.
- Linear Equations in Applied Mechanics*, H. F. P. Purday, Oliver & Boyd, Edinburgh-London; Interscience, New York, 1954. xiv + 240 pp. Illus. \$3.50.
- Climatological Atlas of Canada*, Morley K. Thomas. National Research Council, Ottawa, Canada, 1953. 256 pp. Maps. Paper, \$2.
- The Exploration of Space*, Arthur C. Clarke. Pocket Books, New York, 1954. xii + 210 pp. Illus. + plates. Paper, \$0.35.
- The Physics of Viruses*, Ernest C. Pollard. Academic Press, New York, 1953. xi + 230 pp. Illus. \$5.50.
- Biographical Memoirs*, vol. XXVIII. National Academy of Sciences, Washington, D.C., 1954 (Order from Columbia Univ. Press, New York). 311 pp. Plates. Paper, \$4.
- The Wealth of India: Raw Materials*, vol. III, D-E. A dictionary of Indian raw materials and industrial products. B. N. Sastri, Ed. Council of Scientific and Industrial Research, New Delhi, 1952. xx + 236 pp. Index to vols. I-III, xxx pp. Illus. + plates. R. 18.
- Alternating-Current Machines*, A. F. Puchstein, T. C. Lloyd, and A. G. Conrad. Wiley, New York and Chapman & Hall, London, ed. 3, 1954. xii + 721 pp. Illus. \$8.50.
- Methods of Surveying and Measuring Vegetation*, Dorothy Brown. Commonwealth Agricultural Bureaux, Bucks, England, 1954. xv + 223 pp. Illus. + plates. 35s.
- Thoreau*, William Condy. Philosophical Library, New York, 1954. 114 pp. \$3.50.
- Associação Portuguesa para O Progresso das Ciências*, vol. V, sec. 4, *Ciências Naturais*. Imprensa Portuguesa, Porto, 1951. 726 pp. Illus. + plates.
- The Human Animal*, Weston La Barre. Univ. of Chicago Press, Chicago, 1954. xv + 372 pp. Illus. \$6.
- Endokrinologische Psychiatrie*, M. Bleuler. Georg Thieme, Stuttgart, Germany; Intercontinental Medical Book, New York, 1954. xi + 498 pp. DM. 46.50.
- Master's Theses in Science, 1952*, Barton Bledsoe, Ed. Biblio Press, Washington, D.C., 1954. 252 pp. \$7.
- Air Pollution and Community Health*, Clarence A. Mills. Christopher Publ. House, Boston, 1954. 180 pp. \$2.75.
- Residual Stresses in Metals and Metal Construction*, William R. Osgood, Ed. Reinhold, New York, 1954. xii + 363 pp. Illus. \$10.
- Entomology (Medical and Veterinary)*. Including insecticides and insect and rat control. D. N. Roy and A. W. A. Brown. Excelsior Press, Calcutta, ed. 2, 1954. ix + 413 pp. Illus. \$8.
- Ion Transport Across Membranes*. Paper presented at a symposium at the College of Physicians and Surgeons, Columbia University, Oct. 1953. Hans T. Clarke and David Nachmansohn Eds. Academic Press, New York, 1954. xi + 298 pp. Illus. \$7.50.
- Aesthetics and Language*, William Elton, Ed. Philosophical Library, New York, 1954. vi + 186 pp. \$4.75.
- Los Trigos de la Ceres Hispánica de Lagasca y Clemente*, Ricardo Tellez Molina and Manuel Alonso Peña. Instituto Nacional de Investigaciones Agronómicas, Madrid, 1952. xii + 516 pp. Illus. + plates.
- The Physician and His Practice*, Joseph Garland, Ed. Little, Brown, Boston, 1954. xii + 270 pp. \$5.
- Die Evolution der Organismen*, Ergebnisse und Probleme der Abstammungslehre. No. 2, *Die Geschichte der Organismen*, Gerhard Heberer, Ed. Gustav Fischer, Stuttgart, Germany, ed. 2, 1954. 247 pp. Illus. Paper, DM. 17.70.
- 1951 Impairment Study*, Society of Actuaries. Metropolitan Life Insurance Co., New York, 1954. 300 pp. \$7.50.
- New Research Techniques in Physics*, Symposium (UNESCO) sponsored by the International Union of Pure and Applied Physics (Chapters in English, Spanish, and Portuguese). Academia Brasileira de Ciencias, Rio de Janeiro, 1954. 447 pp. Illus.
- Fundamentals of College Mathematics*, John C. Bixey and Richard V. Andree. Holt, New York, 1954. xiv + 609 pp. Illus. \$5.90.
- Physical Properties of Solid Materials*, C. Zwikker. Interscience, New York; Pergamon Press, London, 1954. viii + 300 pp. Illus. + plates. \$8.75.

- The Theory of Metals.* A. H. Wilson. Cambridge Univ. Press, New York, ed. 2, 1953. 346 pp. Illus. \$8.50.
- An Annotated Bibliography of Submarine Technical Literature: 1557 to 1953.* Committee on Undersea Warfare. National Research Council, Washington, D.C., 1954. xiii + 261 pp. Paper, \$1.50.
- Tobacco Dictionary.* Raymond Jahn, Ed. Philosophical Library, New York, 1954. 199 pp. \$5.
- How to Understand Propaganda.* Alfred McClung Lee. Rinehart, New York, 1952. xii + 281 pp. \$3.
- Proceedings of the Seventh International Botanical Congress.* Held in Stockholm, 12-20 July 1950. Hugo Osvald and Ewert Aberg, Eds. Almqvist & Wiksell, Stockholm; Chronica Botanica, Waltham, Mass., 1953. 899 pp. Plates. \$17.35.
- X-Ray Diffraction Procedures.* For polycrystalline and amorphous materials. Harold P. Klug and Leroy E. Alexander. Wiley, New York; Chapman & Hall, London, 1954. xiii + 716 pp. Illus. \$15.
- The Science Book of Space Travel.* Harold Leland Goodwin. Franklin Watts, New York, 1954. vi + 213 pp. Illus. \$2.95.
- The Technical Report.* Its preparation, processing, and use in industry and government. B. H. Weil, Ed. Reinhold, New York, 1954. xii + 485 pp. Illus. \$12.
- The Painted Men.* T. C. Lethbridge. Philosophical Library, New York, 1954. 208 pp. Illus. + plates. \$6.
- Gas Dynamics of Thin Bodies.* F. I. Frankl and E. A. Karpovich. Trans. by M. D. Friedman. Interscience, New York-London, 1954. viii + 175 pp. Illus. \$5.75.
- Atomic and Free Radical Reactions.* vols. I and II. ACS Monograph Ser. E. W. R. Steacie. Reinhold, New York, ed. 2, 1954. x + 901 pp. Illus. Set, \$28.
- Human Engineering Guide for Equipment Designers.* Wesley E. Woodson. Univ. of California Press, Berkeley, 1954. 5 chaps. Illus. Paper, \$3.50.
- Atlas of Men.* A guide for somatotyping the adult male at all ages. William H. Sheldon. Harper, New York, 1954. xvi + 357 pp. Illus. \$10.
- Abhandlungen aus der Sowjetischen Physik.* Folge III. Gesellschaft für Deutsch-Sowjetische Freundschaft. Robert Rompe, Ed. Verlag Kultur und Fortschritt, Berlin, 1953. 347 pp. Illus. + plates.
- List of Land Mammals of New Guinea, Celebes, and Adjacent Islands, 1758-1952.* Eleanor M. O. Laurie and J. E. Hill. British Museum (Natural History), London, 1954. 175 pp. + 3 plates. £1 10s.
- Bibliography on Research Administration—Annotated.* George P. Bush. University Press, Washington, D.C., 1954. v + 146 pp. \$4.
- Proceedings of the Second National Cancer Conference, 1952.* vols. I and II. American Cancer Society, New York, 1954. 1687 pp. + index. Illus. Set, \$7.50.
- Abhandlungen aus der Sowjetischen Astronomie.* Folge II. Gesellschaft für Deutsch-Sowjetische Freundschaft. Otto Singer, Ed. Verlag Kultur und Fortschritt, Berlin, 1951. 223 pp. Illus.
- The Method of Trigonometrical Turns in the Theory of Numbers.* I. M. Vinogradov. Trans. by K. F. Roth and Anne Davenport. Interscience, New York-London, 1954. x + 180 pp. \$5.
- Science and Civilisation in China.* vol. I, *Introductory Orientations.* Joseph Needham. Cambridge Univ. Press, New York, 1954. xxxviii + 318 pp. Illus. + plates + maps. \$10.
- Geographical Essays.* William Morris Davis. Douglas Wilson Johnson, Ed. Dover, New York, 1954. vi + 777 pp. Illus. \$5.50.
- The Zoo Comes to You.* Burr W. Leyson and Ruth Manecke. Dutton, New York, 1954. 88 pp. Illus. \$2.95.
- Rutherford: By those who knew him.* Being the collection of the first five Rutherford lectures of the Physical Society. Physical Society, London, 1954. 69 pp. Illus. + plates. Paper, 8s. 6d.
- Organic Chemistry.* A one-semester course. Lawrence H. Amundsen. Holt, New York, 1954. xii + 368 pp. Illus. \$4.75.
- Annual Review of Plant Physiology,* vol. 5. Daniel I. Arnon and Leonard Machlis, Eds. Annual Reviews, Stanford, Calif., 1954. ix + 399 pp. \$7.
- Africa Drums.* Richard St. Barbe Baker. George Ronald, Wheatley-Oxford, Eng. and British Book Centre, New York, rev. ed., 1954. 159 pp. Plates. \$3.
- Faune de France.* vol. 58, *Mollusques Opisthobranchés.* Alice Pruvot-Fol. Lechevalier, Paris, 1954. 460 pp. Illus. + plate. Paper, F. 6500.
- The Interrelations of Demographic, Economic and Social Problems in Selected Underdeveloped Areas.* Proc. of a round table at the 1953 annual conference. Milbank Memorial Fund, New York, 1954. 200 pp.
- Qualitative Inorganic Analysis.* A new physico-chemical approach. G. Charlot. Trans. by R. C. Murray. Methuen, London and Wiley, New York, ed. 4, 1954. xi + 354 pp. Illus. \$7.
- The Symbols of Religious Faith.* A preface to an understanding of the nature of religion. Ben Kimpel. Philosophical Library, New York, 1954. x + 198 pp. \$3.75.
- Weather Modification: Past, Present and Future.* Kenneth M. Arenberg et al. Weather Modification Group, Wollaston, Mass., 1954. 50 pp. Paper, \$3.
- Biochemistry and Human Metabolism.* Burnham S. Walker, William C. Boyd, and Isaac Asimov. Williams & Wilkins, Baltimore, ed. 2, 1954. xii + 904 pp. Illus. \$10.
- Indian Corn in Old America.* Paul Weatherwax. Macmillan, New York, 1954. ix + 253 pp. Illus. + plates. \$7.50.
- Biochemistry of Cancer.* Jesse P. Greenstein. Academic Press, New York, ed. 2, 1954. xiii + 653 pp. Illus. \$12.
- Hydraulic Systems and Equipment.* R. Hadekel. Cambridge Univ. Press, New York, 1954. viii + 224 pp. Illus. \$3.75.
- The Kinetic Basis of Molecular Biology.* Frank H. Johnson, Henry Eyring, and Milton J. Polissar. Wiley, New York; Chapman & Hall, London, 1954. vii + 874 pp. Illus. \$15.
- Résistance et Soumission en Physio-Biologie.* L'hibernation artificielle. H. Laborit. Masson, Paris, 1954. 120 pp. Illus. Paper, F. 650.
- Antibodies and Embryos.* F. W. Rogers Brambell, W. A. Hemmings, and M. Henderson. Athlone Press, London, 1951; John de Graff, New York, 1954. 103 pp. Illus. \$2.25.
- L'Instabilité en Mécanique.* Automobiles, avions, ponts suspendus. Y. Rocard. Masson, Paris, 1954. viii + 239 pp. Illus. Paper, F. 1200.
- The Theory of the Photographic Process.* C. E. Kenneth Mees. Macmillan, New York, rev. ed., 1954. x + 1133 pp. Illus. \$21.50.
- Mineral Nutrition of Fruit Crops.* Deciduous and evergreen tree and small fruits. Norman Franklin Childs, Ed. Horticultural Publ., Rutgers Univ., New Brunswick, N.J., 1954. 907 pp. Illus. + plates. \$10.
- Méthodes et Réactions de l'Analyse Organique.* vol. III, *Réactions Colorées et Fluorescences.* Maurice Pesze and Pierre Poirier. Léon Velluz, Ed. Masson, Paris, 1954. 297 pp. Paper, F. 2750.

## Miscellaneous Publications

- Stabilized Turf Shoulders.** Highway Research Bd. Spec. Rpt. 19. 13 pp. Illus. 30¢. **Nutrition under Climatic Stress.** Proc. of a symposium sponsored by the Quartermaster Food and Container Inst. for the Armed Forces (Order from Quartermaster Food and Container Inst. for the Armed Forces, Chicago 9). 204 pp. Illus. Gratis. Natl. Acad. of Sciences—Natl. Research Council, Washington 25, 1954.
- The Marching of Beech.** Beech Utilization Ser., No. 9. S. H. McIntire. Northeastern Forest Expt. Sta., Upper Darby, Pa., 1954. 6 pp.
- Social Aspects of Farm Ownership and Tenancy in the Arkansas Coastal Plain.** Bull. 545. J. L. Charlton. Agr. Expt. Sta., College of Agr. Univ. of Arkansas, Fayetteville, 1954. 85 pp. Illus.
- Sealing of Joints in Concrete Canal Linings, with Special Reference to the Kiowa Hydroelectric Project.** Div. of Building Research Tech. Paper No. 1. B. M. Holmes. Commonwealth Scientific and Industrial Research Organization, Melbourne, 1954. 32 pp. Illus.
- A Supplement to W. M. Tattersall's Review of the Mysidacea of the United States National Museum.** Proc. of the U.S. Natl. Museum, vol. 103, No. 3334. Albert H. Banner. Smithsonian Institution, Washington 25, 1954. 9 pp.
- West Coast Marine Shells.** Occasional Paper No. 9. Myrtle E. Johnson. San Diego Soc. of Natural History, San Diego, Calif., rev. ed. 1954. 36 pp. Illus.
- Aluminum Association Alloy Designation System for Wrought Aluminum.** Effective 1 Oct. 1954. Aluminum Assoc., New York 17, 1954. 4 pp.
- The Smog Problem in Los Angeles County.** A report by Stanford Research Inst. Western Oil and Gas Assoc., Los Angeles 14, 1954. 134 pp. Illus. Gratis.
- Effect of Lecithin on the Dispersion of Titanium Dioxide in Latex Paints.** Max Kronstein. Office of Information Services, New York Univ., New York 53, 1954. 8 pp. Illus. 25¢.
- Catalogue of Rock Collections.** Pt. 3, Antarctica and Australasia. W. Campbell Smith and P. M. Game. British Museum (Natural History), London, 1954. 90 pp. 12s.
- Die Verhaltensweisen der Form.** Pt. 6 of *Die Forschung am Menschen*. Egon Freiherr von Eickstedt. Ferdinand Enke, Stuttgart, Germany, 1954. 135 pp. Illus.
- Fifty Years of Graduate Education at the University of Wisconsin.** Conrad A. Elvehjem, W. J. Brogden, and J. Homer Herriott. Wisconsin Alumni Research Foundation, Madison, 1954. 72 pp. Illus.
- Staff Publications, 1945-1952.** Bull., vol. 90, No. 3. Polytechnic Inst. of Brooklyn, Brooklyn 1, N.Y., 1954. 66 pp. Gratis.
- Seasonal Variation in Production and Price as It Affects Profits from Egg Production.** Circ. 134. Earnest M. Morrison and Roice H. Anderson. Agr. Expt. Sta., Utah State Agr. College, Logan, 1954. 15 pp. Illus.
- The Pacific Islander and Modern Commerce.** Tech. Paper No. 54. V. D. Stace. South Pacific Commission, Noumea, New Caledonia, 1954. 29 pp. Illus. 2s.
- Conditions Physico-Chimiques et Biologiques, et Statistiques de la Pêche dans 48 Lacs du Parc des Laurentides.** vol. 2. Vadim D. Vladikov. Univ. of Montreal, Montreal 2. 177 pp.
- Thesis Abstracts and Faculty Publications.** Case Inst. of Technology, Cleveland, 1954. 39 pp.
- General Survey of the British Pharmacopoeia 1953.** A series of lectures by members of the British Pharmacopoeia Commission 1948-1953. Pharmaceutical Press, London, W.C.1, 1954. 44 pp. 4s 6d.
- Ninth Report of the Biological Bureau, 1951-1952.** Game and Fisheries Dept., Quebec, 1953. 521 pp. Illus.
- Statistical Theory of Extreme Values and Some Practical Applications.** Applied Mathematics Ser., No. 33. Emil J. Gumbel. Natl. Bur. of Standards, Washington 25, 1954 (Order from Supt. of Documents, GPO, Washington 25). 51 pp. Illus. 40¢.
- Annual Report 1953.** Bernice P. Bishop Museum, Honolulu, 1954. 57 pp. Illus.
- Guía para la Clasificación de los Datos Culturales.** Tech. Manual 1. Pan American Union, Washington 6, 1954. 248 pp.
- New Hope for the Retarded Child.** Public Affairs Pamph. No. 210. Walter Jacob. Public Affairs Committee, New York 16, 1954. 28 pp. Illus. 25¢.
- Methodological, Psychiatric and Statistical Study of a Large Swedish Rural Population.** Tage Larsson and Torsten Sjögren. Ejnar Munksgaard, Copenhagen, 1954. 250 pp. Illus. Kr. 25.
- Annual Report 1953.** Leo Noro. Occupational Medical Foundation, Inst. of Occupational Health, Helsinki, Finland, 1954. 43 pp. Illus.
- Conference Transactions of 18th Annual Meeting.** Held at Mellon Inst. 18 Nov. 1953. Bull. No. 27. Industrial Hygiene Foundation of America, Pittsburgh 13, 1954. 183 pp. Illus. \$3.
- L'Évolution de la Partie Optique du Microscope au Cours du Dix-Neuvième Siècle.** Communication No. 89. Ed. Frison. Musée National d'Histoire des Sciences Exactes et Naturelles, Leiden, Netherlands, 1954. 168 pp. Illus.
- Annual Report 1953.** East Malling Research Sta., Maidstone, Kent, England, 1954. 232 pp. Illus. \$2.
- The Plum Curculio on Peaches in Arkansas.** Bull. 542. W. D. Wylie. Agr. Expt. Sta., College of Agriculture, Univ. of Arkansas, Fayetteville, 1954. 46 pp. Illus.
- Potentiometric-Model Study of Edge-Water Encroachment.** Quarterly, vol. 49, No. 3. Warren J. Mason. Colorado School of Mines, Golden, 1954. 30 pp. Illus. \$1.
- Gum Flow and Pitch-soak in Virginia Pine Following Fusarium Inoculation.** Sta. Paper No. 40. George H. Hepting. 8 pp. Illus. **Pine Sawmilling Costs by Log Size: An Estimating Method.** No. 43. Walter C. Anderson. 16 pp. Southeastern Forest Expt. Sta., Asheville, N.C., 1954.
- Metabolic Integrations.** P. G. Watson. W. Heffer & Sons, Cambridge, England, 1954. 12 pp. 4s.
- Indigenous Cellulosic Raw Materials for the Production of Pulp, Paper, and Board.** Pt. 17, *Writing and Printing Papers from Castor Stems (Ricinus communis, Linn.)*. Indian Forest Bull. No. 176. R. V. Bhat and Narendra S. Jaspal. Manager of Publications, Delhi, India, 1954. 6 pp.
- Die Evolution der Organismen.** Ergebnisse und Probleme der Abstammungslehre. No. 1. Gerhard Heberer, Ed. Gustav Fischer, Stuttgart, Germany, 1954. 172 pp. Illus. DM. 12.10.
- Bibliography and Index of Literature on Uranium and Thorium and Radioactive Occurrences in the United States.** Pt. 2, California, Idaho, Montana, Oregon, Washington, and Wyoming. Bull., vol. 64. Margaret Cooper. Geological Soc. of America, New York 27, 1953. 69 pp.

# Technical Papers

## Paper Chromatographic Identification of the Actinomycins

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The actinomycins, in common with many other antibiotics containing a polypeptide moiety, have been demonstrated to consist of a group of closely related compounds probably differing only in the kind, number, and arrangement of their amino acids (1).

By means of countercurrent distribution studies using solvent systems containing *n*-dibutyl ether, methyl butyl ether, and the sodium salts of aromatic sulfonic acids in water, Brockmann and coworkers (2, 3) were able to show that actinomycin C consisted of at least three components, C<sub>1</sub>, C<sub>2</sub>, and C<sub>3</sub>. Actinomycin X was also separated into three components, X<sub>0</sub>, X<sub>1</sub>, and X<sub>2</sub>, and was, as far as could be ascertained, indistinguishable from actinomycin B. Actinomycin I (4) appeared to be an almost homogeneous substance, identical with a sample supplied by our laboratory as actinomycin A (see later). Circular paper chromatography employing similar solvent systems also separated the actinomycins into their components, and parallel results were obtained (3, 5).

In view of the successful separation of basic antibiotics by paper chromatography with solvent systems containing *p*-toluenesulfonic acid (6), a similar method was applied to the actinomycins (7). Mixtures of *n*-butyl ether and benzene or ethyl acetate with aqueous solutions of a number of aromatic sulfonic acids were tested and found satisfactory. *N*-dibutyl ether, ethyl acetate, 2 percent naphthalene- $\beta$ -sulfonic acid (3:1:4) was chosen as the most suitable. Excellent results were obtained with this system using either circular or ascending techniques. Whatman No. 1 paper was dipped in the aqueous phase and blotted between sheets of filter paper, and samples of the actinomycins to be tested were applied in acetone solution. The deep red color of the naphthalene- $\beta$ -sulfonic acid salt facilitated detection of the zones.

The following samples of actinomycin were examined: (i) authentic actinomycin A produced from *S. antibioticus* 3435 (8) in 1940; (ii) actinomycin produced from *S. antibioticus* 3435 (8) in 1953; (iii) actinomycin B obtained from Hoffman LaRoche; (iv) an actinomycin produced from a species of *Streptomyces* obtained from Merek & Co., under their No. 6009; (v) an actinomycin, also designated as actinomycin B, produced from *Streptomyces* sp. 3687 (8) obtained from Delft, Holland; (vi) actinomycin C produced from *S. chrysomallus* 3657 (8); (vii) actinomycin D produced from *S. parvulus* 3677 (8), a new strain isolated in our laboratory in 1953 (9); (viii) an actinomycin produced from *Streptomyces* sp. 3491 (8) isolated in our laboratory in 1948; (ix) an ac-

tinomycin produced from *Streptomyces* sp. 3436 (8) isolated in our laboratory in 1944.

Resolution of the actinomycins into corresponding components was obtained by ascending paper chromatography. The results are summarized in Table 1. By circular paper chromatography, identical separations were achieved.

The actinomycins from the Merek and Delft strains showed no detectable differences from actinomycin B. In the actinomycin produced from strain 3491, the component of Rf 0.54 appeared to be present in much greater concentration than in actinomycin B, whereas that at Rf 0.30 was present in only trace amounts. The actinomycin A produced in 1953 differed from that produced from the same culture in 1940 in showing a trace of the component at Rf 0.02. Although it is possible that the composition of the actinomycin produced by this culture has changed slightly in the course of time, the methods of growing the culture and of isolating these two products were not identical, and there is some evidence to indicate that, as a result of repeated chromatography and recrystallization, the component at Rf 0.02 is removed from the material.

It has recently been verified that a sample supplied to H. Brockmann by this laboratory in 1949 as actinomycin A was, in fact, the actinomycin produced by culture 3436. At that time the heterogeneous nature of the actinomycins had not been recognized and, since the two products showed no outstanding differences in physical and chemical properties, they were assumed to be identical. As a result of the present study, although their similarity is confirmed, since each has the component at Rf 0.30 as the major fraction, they are shown to possess additional components in different proportions. Brockmann's actinomycin I is, therefore, identical, not with actinomycin A but with the actinomycin from strain 3436.

Table 1. Results of resolution of actinomycins into corresponding components.

Sample	Rf				
	0.02	0.30	0.47	0.54	0.60
Actinomycin A (produced in 1940)		xxx		xx	
Actinomycin A (produced in 1953)	x	xx		xxx	
Actinomycin B	x	xx		xxx	
Actinomycin from Merek culture 6009	x	xx		xxx	
Actinomycin from culture 3687	x	xx		xxx	
Actinomycin C		x	xx		xx
Actinomycin D		xxxx			
Actinomycin from culture 3491	x	x		xxxx	
Actinomycin from culture 3436	x	xxxx		x	



The actinomycin produced by *S. parvulus* behaves in our solvent system as a homogeneous substance and, since it is therefore different from any other actinomycin hitherto reported, we have proposed for it the name actinomycin D. Full details of the preparation and properties will be reported at the Symposium on Antibiotics, Washington, D.C., in Oct. 1954.

Whether those components from different actinomycins that have the same Rf value are, in fact, identical substances is at present under investigation. In view of the possible influences of the composition of the broth and the method of isolation on the proportion of the components present in each actinomycin, we have not assigned a distinguishing letter to the actinomycin produced by strain 3491.

We wish to express our appreciation to M. Tischler, of Merck & Co., who supplied the sample of authentic actinomycin A and the actinomycin from Merck strain 6009, to J. A. Aeschlimann of Hoffman LaRoche for actinomycin B, to the Northern Regional Research Laboratories for the *S. chrysomallus* culture, and to Dr. van der Laan of the Kon. Ned. Gist and Spiritusfabrik of Delft, Holland, for the actinomycin from strain 3687. The remaining actinomycins were isolated in this laboratory, and we are indebted to R. A. Manaker and F. J. Gregory for the preparation of many of the samples.

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- 13 April 1954.

### Polarography with a Dropping Gallium Electrode

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The universal and almost exclusive use of the dropping mercury electrode in polarography depends on the unique properties of this metal. Gallium being the only other metal still liquid at ordinary temperature (mp 29.7°C), it could conceivably serve in a dropping electrode; however, its other properties are quite unsuited for that purpose, as was confirmed by the present unsuccessful attempt. Not only is gallium scarce and expensive, but also it is readily oxidized

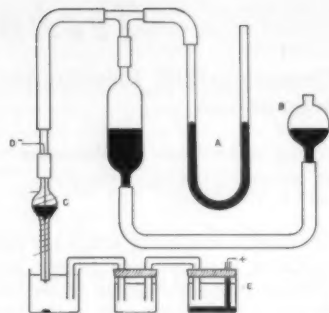


Fig. 1. Experimental arrangement of the dropping gallium electrode and electrolysis cell.

in air. The oxide coating, which in the solid prevents further oxidation, is continuously renewed in the molten state. As a result, liquid gallium wets glass, a condition most objectionable in a dropping electrode. Furthermore, it is less than half as dense as mercury, and its hydrogen overvoltage is quite small. Finally, it expands on freezing, as do antimony and bismuth.

Since only about 4 ml (25 g) of metallic gallium, 99.99-percent pure (1) was available, a special capillary electrode was needed (Fig. 1). The capillary itself (bore diameter about 0.05 mm) had a small bulb C of some 10-ml capacity blown at a short distance from the tip to hold the supply of gallium; electric contact with this was secured through a fine platinum wire D sealed at the top. To make the liquid metal flow from the electrode, air pressure had to be applied over it by means of a leveling bulb B and a mercury reservoir. Although liquid gallium supercools readily, the polarographic cell was kept at 30°C in a constant temperature bath, and the electrode was wound with electrically heated resistance wire. The reference electrode E (saturated calomel) was of the external type to prevent the dropping gallium from mixing with the mercury of the anode. For working in absence of dissolved oxygen, some sodium sulfite was added to the electrolyte (0.1N KCl). The electric resistance of the entire circuit was about 2000 ohms. The current-voltage curves were recorded with a Sargent Model XI polarograph.

Despite all precautions, this gallium electrode always behaved erratically, especially with regard to dropping rate. This could never be reproduced from one run to the other with a given applied pressure. Therefore the figures in Table 1 must be taken only as a rough indication. Because the density of gallium is less than half that of mercury, while its surface is about 50 percent greater, one could expect that the drops falling from a certain capillary would be much larger than those of mercury; actually a factor of about 5 was observed. For the same reasons, the current intensity was proportionally higher. The measured rate of flow of gallium through the capillary electrode was appreciably greater than that calculated with the well-known equation (2) based on Poiseuille's



Table 1. Characteristics of mercury and gallium dropping from the same capillary;  $r^2/l = 1.13 \times 10^{-3} \text{ cm}^2$  for the capillary.

Characteristics	Mercury		Gallium	
	Air	0.1N KCl	Air	0.1N KCl
$P$ (cm Hg)	14	14	24	24
$W$ (mg)	32.3	4.84	72	11
$t$ (sec)	4.77	0.71	26	3.8
$m$ (mg sec $^{-1}$ )	6.76	6.82	2.8	2.8
$m^{2/3}t^{1/3}$	4.53	3.35	3.1	2.3
$P/m$	2.06	2.06	19	19
$r(\times 10^{-3} \text{ ml})$	2.38	0.36	12	2

law. On substituting the appropriate numerical values for the coefficient of surface tension, 600 dynes  $\text{cm}^{-1}$ , and the coefficient of viscosity, 2.09 centipoise (3), the equation becomes

$$m = \frac{6.84 \times 10^{-4} r^4}{l} \left( h' - \frac{7.9}{m^{1/2} t^{1/2}} \right),$$

where  $h'$  is expressed in terms of centimeters of gallium. In general, the drop time seemed to vary much more with the applied voltage than in the case of mercury, although the electrocapillary curves of both metals have about the same shape (4, 5). Also the size of capillary bore capable of producing reasonable rates of flow was found to be rather critical.

The only current-voltage curve that could be fairly well reproduced was obtained with an air-saturated 0.1N KCl solution (Fig. 2). It shows the following features: the dropping gallium electrode has a potential of  $-1.0 \text{ v}$  (versus saturated calomel electrode) as indicated by the value of applied emf at zero current. Thus it is anodically polarized at lower applied voltage. The portion of the curve corresponding to that region is quite similar to that for mercury with the difference that the current intensity is much greater, as explained in the preceding paragraph.

On the cathodic polarization side, a fairly well defined wave occurs with a half-wave potential of  $-1.26 \text{ v}$ ; the current at that point was of the order

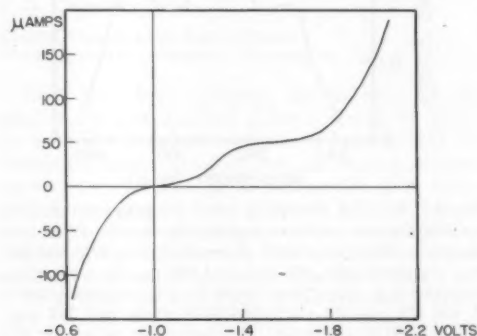


Fig. 2. Current-voltage curve for the dropping gallium electrode in air-saturated 0.1N KCl solution.

of 30  $\mu\text{amp}$ . Since that wave disappeared entirely in an oxygen-free solution, it corresponds probably to the reduction of the gallic ions produced by reaction of the metal with dissolved oxygen. This conclusion is borne out by the fact that the cathodic half-wave potential is the same as that of the gallic ion (6, 7). Beyond  $-1.6 \text{ v}$ , the current increased sharply owing to hydrogen evolution. Because of the numerous difficulties encountered, no attempt was made to study the reduction of other metal ions at the dropping gallium electrode.

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29 April 1954.

#### Identification of the So-called "Lard Factor" as Vitamin A\*

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Discovery of a new vitamin was announced by Kaunitz, Slanetz, and Johnson in 1950 (1). It could be concentrated by molecular distillation of freshly rendered lard and was designated the "lard factor." The scope of this claim was subsequently modified, and reports from the same laboratory (2-5) showed that the disease described was simply classical vitamin-A deficiency. The new factor was then considered to be a substance possessing biological activity of vitamin A but differing chemically from known forms of vitamin A. The content of vitamin A was claimed to be less than  $10^{-7} \text{ g}$  per gram of distillate (0.33 IU/g) as the result of analyses by the usual chemical and spectrophotometric methods.

Lowe, Morton, and Harrison (6) and Lowe and Morton (7) bioassayed a similar lard distillate and found approximately 10 IU of vitamin-A activity per gram. They reported that "Neither preformed vitamin A nor carotenoid provitamin A could be detected by spectrophotometric or colorimetric tests on lard or lard unsaponifiable matter before or after chromatography, or on lard distillate," and concluded that the existence of the "lard factor" was confirmed.

Conversely, Engel (8) reported no indication of the presence of a "lard factor" in fresh lard that he fed to vitamin-A-depleted rats at a 10-percent level in the diet. Recently Herb, Riemenschneider, Kaunitz, and Slanetz (9) reinvestigated two lard distillates and found indications of the presence of vitamin A. These

small amounts of vitamin A were estimated by spectrophotometric analysis of the chromatographed unsaponifiable fraction. Consequently, these investigators withdrew their previous claims and concluded that "typical vitamin A is present in lard and probably accounts for most of its biological vitamin A activity." The existence of the lard factor was considered unlikely but was "not completely excluded."

The results of our investigations have established that the so-called lard factor in molecular distillates of lard is in fact vitamin A. We acknowledge with thanks the cooperation and assistance of the members of the Vitamin Development and Manufacturing Control Laboratories of DPI with this investigation.

We have analyzed various lard distillates colorimetrically following careful saponification and found a range of apparent vitamin-A content from 5.5 to 28 units/g, corresponding to 0.5 to 2.5 units/g in the original lard sample, as is shown in Table 1.

Table 1. Vitamin-A analyses of lard distillate.\*

Sample No.	Distillate fraction of original input lard (%)	Unsaponifiable matter in distillate (%)	Vitamin A in distillate (units/g)	Calculated vitamin A in original lard (units/g)
D-4-80	10.1	1.67	6	0.6
D-4-99	8.6	2.64	7.8	0.9
D-Q-614	9.0	4.36	5.5	0.6
25104	13.0	1.9	7	0.5
25104	13.0	1.0	6.8	0.5
65009	11.4	2.2	17	1.5
65017-1	11.0	1.82	28	2.5
65017-2	11.0	1.84	22	2.0

\* Freshly rendered lard was molecularly distilled at 215°C and 10<sup>-6</sup> mm Hg pressure. The first fraction, representing approximately 10 percent of the original lard, was removed, saponified, and assayed for vitamin A by the Carr-Price reaction. It is impossible to determine accurately the small amounts of vitamin A present by the USP XIV procedure involving the Morton-Stubbs correction for extraneous absorption. The stills were carefully cleaned to eliminate the possibility of chance contamination of these distillates with vitamin A.

Additional evidence of the identity of vitamin A in lard distillates was obtained, as is shown in Table 2. A lard distillate and a sample of the unsaponifiable matter from the same lard distillate were bioassayed by the standard USP method. The two preparations were analyzed by the increment blue color test as described in the USP XIV. This technique corrects for any inhibition of the Carr-Price blue color by the test material and is generally considered to be a good identity test for vitamin A. It appears from the results of this test that all the bioactivity can readily be accounted for by chemically measured vitamin A present.

Positive identification of vitamin A in the two distillates was made by applying the anhydrous HCl dehydration procedure of Shantz, Cawley, and Embree

Table 2. Vitamin-A content of lard distillates determined by bioassay and physicochemical methods.

Type of analysis	Sample	
	Lard distillate (25104)	Unsaponifiable fraction (RL-11-20-51) of lard distillate (25104) in cottonseed oil*
Biopotency $\pm$ S.E.† (units/g)	5.01 $\pm$ 1.18	62.5 $\pm$ 9.9
Increment blue color value‡ (units/g)	6.18	135
Dehydration value§ (units/g)	4.75	104

\* The unsaponifiable fraction of lard distillate in oil solution was obtained as follows: 700 g of distillate was saponified for 2 hr in 105 ml of ethanol with 210 g of 85 percent KOH in 350 ml water. The mixture was diluted with 5 lit water and extracted 5 times with a total of 8½ lit of ethyl ether. The ether extracts were concentrated to 250 ml, a 50-ml aliquot removed for analysis, and 20.0 g of refined cottonseed (Wesson) oil added to the remaining 200 ml. The ether was then removed under vacuum, leaving a solution of unsaponifiable matter in cottonseed oil.

† Rat growth bioassays were routine tests in which two levels of test substance were compared with two similar levels of the USP Vitamin A Reference Standard. A modified USP XIII bioassay procedure for vitamin A was employed, as suggested by Bliss (12).

‡ The potency by increment blue color was determined as outlined in the USP XIV.

§ A portion of the unsaponifiable fraction was treated with alcoholic HCl, and the resulting anhydrovitamin A was determined as described by Shantz *et al.* (10).

(10). This dehydration reaction has been used successfully to prove the presence of vitamin A in human blood extracts (11). It consists essentially of subtract-

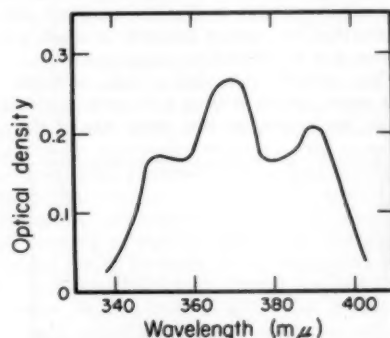


Fig. 1. Spectral absorption curve for anhydrovitamin A by dehydration of the unsaponifiable matter from lard distillate. Maximums were observed at 351, 370, and 391 mμ, compared with 351, 371, and 392 mμ for pure anhydrovitamin A. Absorption ratios for pure anhydrovitamin A are 351 mμ/371 mμ = 2500/3650 = 0.68 and 392 mμ/371 mμ = 3180/3650 = 0.87. Corresponding ratios for the anhydrovitamin A from lard distillate of 0.64 and 0.77, respectively, are in excellent agreement.

ing the U.V. absorption curve of the extract suspected of containing vitamin A from the U.V. absorption curve of the extract after the dehydration reaction. If the "difference curve" is the characteristic triple-peak absorption curve of anhydrovitamin A, the presence of vitamin A in the original extract is proved. The absorption curve of the anhydrovitamin A prepared from the unsaponifiable fraction of lard distillate is shown in Fig. 1. This establishes the presence of vitamin A, per se, in the preparation. The results of these determinations give no indication of more vitamin-A bioactivity than can be determined as vitamin A by conventional chemical analyses. The failure of some investigators to find vitamin A in lard concentrates may have been due to loss during saponification of the small amounts of vitamin A present.

Thus, the postulated "lard factor" of Kaunitz and coworkers has been identified as vitamin A. Vitamin A, per se, has been found in amounts sufficient to account for the vitamin-A bioactivity of lard distillates.

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5 April 1954.

## Graphitization of Diamond

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There have been numerous investigations of the graphitization of diamond under a variety of conditions (1-19). From the literature it appears that the diamond-graphite transition rate (in vacuum or inert atmosphere) is zero or immeasurably slow below 1000°C, measurable from 1000° to 1500°C, but at any given temperature has not been reproducibly measured. The temperature at which the transition rate is first measurable has not been established.

An attempt has been made in this laboratory to extend the data on the transition. Each diamond was heated in an atmosphere of dry helium (99.95 percent pure with 0.05 percent H<sub>2</sub>). The sample was placed in a recrystallized alumina crucible fitted with alu-

mina lid which was encased in a graphite crucible and lids. This crucible assembly was suspended in a gas-tight mullite tube through which the dry helium was passed. A protected Pt-Pt 10 percent Rh thermocouple adjacent to the crucible was used to follow the temperature.

Clear, industrial-grade diamond maceles that were free from obvious inclusions were selected. These weighed 10 to 20 mg each, were triangular shaped, were approximately 1 mm thick, and had 2- to 3-mm equilateral sides. Individual experiments, summarized in Table 1, were as follows:

Table 1. Graphitization of diamond.

Wt. of diamond (mg)	Temp. (°C)	Time (hr)	Percent age loss ± 0.2%	Microscopic examination after heating
16.82	1000	16	0.0	No graphitization
16.82	1100	17	.0	
11.88	1200	24	.0	
11.88	1200	50	.0	
18.70	1200	24	.0	
18.57	1300	50	.2	Superficial graphitization
17.14	1400	50	1.1	
17.18	1400	6	0.0	
17.38	1400	24	.6	Black coating
15.24	1400	49	1.2	
11.76	1400	49	2.1	
19.76	1400	48	1.3	
9.71	1400	48	2.1	

1) A diamond was cleaned with acetone, dried, and weighed to ± 0.01 mg.

2) It was placed in the alumina crucible encased in the graphite crucible. The crucibles were covered with lids of alumina and graphite, respectively, and the assembly was placed in the furnace.

3) The helium flow was started and the furnace was equilibrated at the desired temperature.

4) At end of the desired heating time, the furnace was shut off and cooled to room temperature with helium flow continued.

5) The diamond was removed, weighed to ± 0.01 mg, and viewed under a microscope to determine the nature and extent of any change. In some cases x-ray diffraction studies of the surface were made.

6) The diamond was treated with hot perchloric acid and ammonium vanadate to remove any graphite formed.

7) The diamond was cleaned with acetone and reweighed to ± 0.01 mg. The loss in weight was taken as the percentage of graphitization.

A blank on the original material showed no loss in weight upon treatment with hot perchloric acid and ammonium vanadate. The heating time is taken from the time the furnace reached the specified temperature until the heat was turned off. Approximately ½ to 1 hr was needed to reach the specified temperature and approximately ½ hr to cool below 1000°C when the heating current was cut off. The temperatures were maintained within 15°C of those shown in Table 1.

Diamond powders (40-50, 120-140, 230-270, 500, and 4000 mesh) were also heated but with no clear-cut

results. The trend of the data indicates that graphitization starts at temperatures of 50° to 100°C lower than for diamond maceles under the same conditions.

Clear, inclusion-free, industrial-grade diamonds when heated under helium for periods of 50 hr (i) do not graphitize at temperatures below 1200°C, (ii) graphitize superficially at 1300°C, and (iii) show approximately 1 to 2 percent graphitization at 1400°C.

Diamond powders appear to start graphitizing 50° to 100°C below the temperature at which maceles graphitize under the same conditions. As the graphitization proceeds, the crystals become progressively darker brown in color. This color develops even at 900°C in crystals that show no graphite by x-ray diffraction examination.

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## A Sensitive, Inexpensive Light Meter for Photomicrography

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The light meter described here can be used with 35-mm cameras and is suitable for determining the proper exposure for fixed slides or living preparations.

We found standard light meters to be inconvenient for photomicrography for the following reasons: (i) interference of incident light; (ii) inaccurate readings on light of low intensity; (iii) difficult to adapt readily to ocular tubes. The commercial meters made for photomicrography that cost between \$92 and \$110 seemed expensive. We constructed a meter from the

following materials for between \$20 and \$25: photocell (Klett-Summerson type); 5× ocular tube; brass plate for mounting the ocular tube; Simpson 0-50 4-in. scale microammeter; contact switch; metal mounting box.

Figure 1 shows the method of assembly. The 5× ocular tube could be threaded into the plate, but Fred Lindow, the machinist of the Physics Department who aided us, simply pressed the ocular tube into a snugly fitted hole drilled in the plate. The fitting was sufficiently tight that the ocular tube did not need to be sweated in. Appropriate holes were drilled in the brass plate and metal box. These holes coincided with the holes present in the Klett photocell mounting. The microammeter was mounted to the metal box with metal screws, and the necessary electric connections were made.

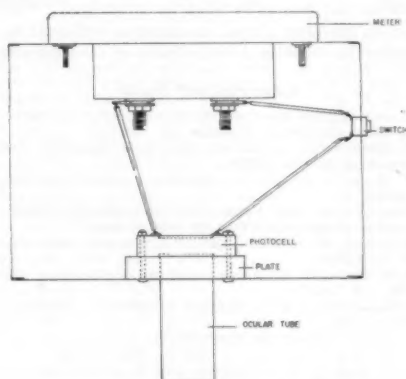


Fig. 1. Assembly of light meter.

The calibration was made with Plus-X, 35-mm film in a Leica camera, using a Micro Ibo attachment. Any other camera of similar type may be used. The calibration was made by controlling the light intensity with neutral filters to give the following meter readings: 1, 5, 10, 15, 20, 25, and 30 (Table 1). The exposed Plus-X 35-mm film was developed in a tank with Ansoo Finex L developer at 20°C for 15 min and fixed in Edwal Quik fix for the required time at 20°C. The film was washed at 20°C for 20 min.

The correct exposure time was determined by visual inspection of the negatives and the printing quality on glossy, normal contrast, projection paper. The

Table 1. Calibration of meter using Plus-X film.

Meter reading	Exposure time (sec)			
1	1/10	1/25	1/50	1/125
5	1/50	1/125	1/200	1/500
10	1/125	1/200	1/500	
15	1/125	1/200	1/500	
20	1/125	1/200	1/500	
25	1/125	1/200	1/500	
30	1/125	1/200	1/500	



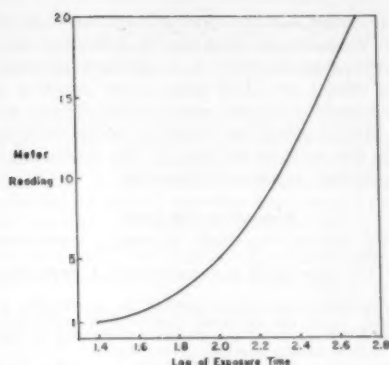


Fig. 2. Calibration curve obtained by plotting meter reading against the log of exposure time.

meter reading was plotted against the log of correct exposure time in seconds (see curve Fig. 2 and Table 2).

The exposure time was found to be constant for any particular meter reading, when the B Wratten (green) filter was used and when objectives were changed.

Table 2. Log of exposure time.

Meter reading	Exposure time (sec)	Log of exposure
1	1/25	1.398
5	1/125	2.017
10	1/200	2.301
15	1/320	2.500
20	1/500	2.699

This was also true for living tissue in agar-slant tubes. After calibrating the meter, 36 exposures were made on Plus-X film at various meter readings using the exposure time indicated by the graph (Fig. 2). The resulting negatives were of equal density displaying the same printing qualities.

Some improvements were suggested after the meter was constructed. (i) The brass plate and steel mounting box could be made of aluminum. (ii) A 0-20 microammeter, 4-in. scale, with resistance shunts, may be used to some advantage. (iii) If additional sensitivity is required, a  $1\frac{1}{2}$ -v dry cell can be wired in series with the microammeter.

This meter can also be used on bellows-type cameras when it is properly calibrated to the conditions employed. The calibrations should be carried out on newly constructed meters.

The meter was constructed in conjunction with research supported by the Cleveland area Heart Society and the Heart Institute of the U.S. Public Health Service. Suggestions from Joe Dereska of the Electronics Laboratory were appreciated.

6 May 1954.

## Effects of Adrenal Medullary Hormones on Antidiuretic Substance in Blood Serum

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O'Connor and Verney (1) suggested that adrenaline inhibits the release of the posterior pituitary antidiuretic hormone (ADH), but their evidence was indirect in nature since they made no attempt to measure antidiuretic substance (ADS) levels in blood. The present investigation (2, 3) represents an attempt to answer the question: Are the diuretic effects of adrenal medullary hormones in the rat (4, 5) due in any part to an inhibition of the release of posterior pituitary ADH?

The design of the experiment was patterned after Ames and van Dyke's (6) modification of the intravenous assay method of Jeffers *et al.* (7). The assay animals were rendered diuretic by the administration of water and ethanol, which anesthetized the rats and probably suppressed the secretion of endogenous antidiuretic substance from the posterior pituitary of the test animal (8). The rats used for assay, as well as the serum donors, were fasted for 18 hr. At the zero hour each assay animal was given 5 ml per 100 g of a 10 percent ethanol solution by gavage. After 30 min, 3 ml water per 100 gm body weight was given in the same manner. Within the following 45 min, the urethra was ligated, the bladder was cannulated, and a hypodermic needle was inserted into the saphenous vein. The needle was left in the vein, and a mandrel was kept in the bore of the needle except during the intravenous injection of the test material. The rat was placed (ventral side down) on a board equipped with a hole that supported a tuberculin syringe barrel (graduated to 0.01 ml) and a hardware cloth cage that served as a restraining device. A polyethylene cannula drained urine from the urinary bladder into the mouth of the syringe barrel whose tip was fitted with a three-way stopcock.

Urine collections were made and recorded at 10-min intervals. Test samples of serum or Pitressin were injected via the previously prepared saphenous vein. Estimations of antidiuretic activity were made by comparing the antidiuretic effect of material to be assayed with that obtained from known amounts of Pitressin in the same assay rat. Duplicate assays of the same dose in the same animal were in agreement.

Serum obtained from blood collected by draining the trunk of decapitated gentle rats did not exhibit antidiuretic properties. Antidiuretic substance (ADS) equivalent to less than 0.11 milliunits (mU) Pitressin per milliliter of serum, was present in blood obtained by decapitation from tranquil rats that had been injected with morphine sulfate, 1 mg/kg (9). No serum ADS was detected in the blood of animals that had been injected with diuretic doses of epinephrine or nor-epinephrine (5) 5 min prior to injection of morphine sulfate. ADS release that follows morphine ad-

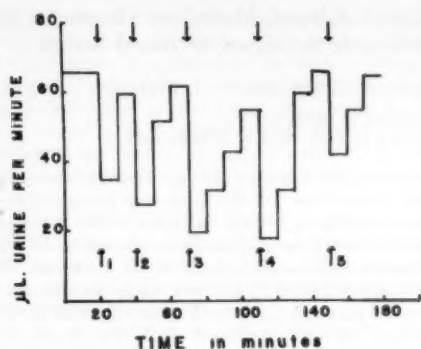


Fig. 1. Typical curve from assay procedure. Intravenous injections were made at the numbered arrows as follows: (1) 20  $\mu$ U Pitressin; (2) 30  $\mu$ U Pitressin; (3) 40  $\mu$ U Pitressin; (4) 50  $\mu$ U Pitressin; (5) 0.2 ml serum from rat exposed to ether for 5 min. The response indicates that the serum contained less than the equivalent of 0.1 mU Pitressin per milliliter.

ministration was not inhibited by a nondiuretic dose of epinephrine (20  $\mu$ g/100 g). ADS release caused by a 5-min exposure to ether could not be blocked by the previous administration of medullary hormones in the doses used here.

Figure 1 illustrates the manner in which the values shown in Table 1 were estimated. At this time only relative values of ADS in blood serums may be assigned to these results. Although the method now employed is only semiquantitative, we regard it as an

Table 1. Effects of medullary hormones on ADS in blood serum of rats.

Treatment	Cases	No. showing ADS	Estimated ADS (mU Pitressin/ml serum)
Decapitation	8	0	0.00
Morphine, 1 mg/kg			
Decapitation	8	8	.11
Epi., 20 $\mu$ g/100 g			
Morphine 1 mg/kg			
Decapitation	5	4	.10
Epi., 100 $\mu$ g/100 g			
Morphine 1 mg/kg			
Decapitation	9	0	.00
Nor-epi., 20 $\mu$ g/100 g			
Morphine 1 mg/kg			
Decapitation	7	0	.00
Ether anesthesia			
Heart puncture	13	11	.18
Epi. 100 $\mu$ g/100 g			
Ether anesthesia			
Heart puncture	15	11	.10
Nor-epi., 20 $\mu$ g/100 g			
Ether anesthesia			
Heart puncture	6	6	.13

accurate index for the detection of ADS in blood serums. We interpret these data as indicating that (i) 5-min exposure to ether is a stronger stimulus in causing release of ADH than is the injection of 1 mg/kg morphine sulfate; and (ii) the diuretic action of the adrenal medullary hormones in the rat may, in part, be due to their blocking of the release of posterior pituitary antidiuretic hormone.

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- \* Present address, Department of Biology, Luther College, Decorah, Iowa.
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30 April 1954.

## A Single Diet for All Living Organisms

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Certain aspects of nutrition as a common denominator of biology are presented to indicate that diet can be considered as a single unit in the variables of biological research. A broad concept of comparative nutrition could be considered if different species could be reared on the same diet. Such a possibility may be induced from two considerations, the first being the great extent to which nutritional principles may be translated from one species to another. This is well illustrated by the fact that some of the individual B-vitamins, essential to the life of animals, were first discovered as microbial growth factors. Literature shows a striking similarity in the semisynthetic diets fed to monkeys, rats, mice, dogs, and chicks. Second, the qualitative nutritional requirements of most animals, plants, and microbial forms studied can be expressed in common terms as 15 to 50 nutritional elements (minerals, amino acids, vitamins, and a few unidentified factors). The suspected role of intestinal microorganisms in the production of vital unidentified factors for the host has been contraindicated by maintaining germfree chicks and rats (1) through one and six generations, respectively. This gives some assur-

ance that the major nutritional factors are present in experimental diets commonly used today.

Both considerations were expressed by Maynard (2):

Superficially, the rations of man and animals have little in common since the kinds of food eaten are so different. Yet the essential constituents of these rations, that is, the elements required for adequate nutrition, are largely the same whatever the species. The general principles of nutrition are identical.

After surveying the nutritional requirements of invertebrate animals, Kidder concludes (3)

... it is impressive that their nutritional patterns should so closely correspond with each other and to those of birds and mammals.

Thus, in theory, it may be possible to nurture all species with one diet. Ideally, this universal diet should contain all nutrients in an available state, with each nutrient in such quantity that it will satisfy the minimum dietary requirement for satisfactory growth, reproduction, and maintenance of all species without eliciting serious toxic reaction in any species. Such a diet would necessarily contain innocuous excess of some nutrients for many species—particularly autotrophs. The functional basis of the diet would not rest upon the nutritional requirements for maximal growth rate in any species; it would be a balance of nutrients with each in proper proportion to the whole to provide adequate nutrition to rear all species.

A diet with the proper formulation of all nutrients required to rear all species may never be known. In our present state of biological understanding, we would not expect to rear most parasites, viruses, fastidious microorganisms, or mammalian tissues with a semisynthetic diet; their complete nutritional requirements are not yet known. A finite end-point that may be anticipated is a diet that includes essential metabolites as nutrients for these parasitic forms. The experimental universal diet approaches the ideal in its ability to nurture selected representatives of the taxonomic classes (or orders) of living organisms. (The use of mere numbers of species without some system of representation would place undue emphasis on those classes with the largest number of species.) Natural universal diets, such as milk (fortified), whole cells (as yeast), or whole animals, would seem to be less useful in an academic study than a synthetic-type diet. Economic aspects could be considered to formulate practical universal diets.

Once written, the hypothesis fired the imagination. A semisynthetic "universal diet" was formulated in September 1952, and mice and guinea pigs were started the following month. Large amounts of vitamins were incorporated in the diet in order to satisfy any extraordinarily high requirement that might be encountered. The diet was made with special considerations for the salt requirements of chicks and guinea pigs, the fiber requirements of rabbits, the high protein requirement of chicks, and the fat requirement of dogs. Sugar was added to give good acceptability

of the diet. The composition of Universal Diet No. 1 is given in grams of ingredient per kilogram of diet: purified casein, 300; corn oil, 80; cornstarch, 300; cellulose (alpha cell), 120; sucrose, 120; total salts, 80 (K acetate, 20.0;  $\text{CaCO}_3$ , 18.0;  $\text{CaHPO}_4$ , 13.5;  $\text{Na}_2\text{HPO}_4$ , 12.0;  $\text{NaCl}$ , 3.0; KI, 0.045;  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , 4.5;  $\text{MgO}$ , 4.0;  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ , 0.75;  $\text{Fe}(\text{C}_6\text{H}_5\text{O}_7)_3$ , 4.5;  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , 0.23;  $\text{CoCl} \cdot 6\text{H}_2\text{O}$ , 0.03;  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ , 0.06;  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ , 0.03;  $\text{AlK}(\text{SO}_4)_2 \cdot 10\text{H}_2\text{O}$ , 0.045); vitamin A, 10,000 IU; vitamin D, 2000 IU; ascorbic acid, 10.0;  $\alpha$ -tocopherol, 0.1; vitamin K (menadione), 0.01; thiamine Cl, 0.02; riboflavin, 0.02; nicotinamide, 0.1; Ca pantothenate, 0.05; inositol, 2.0; choline Cl, 2.0; pyridoxine Cl, 0.02; biotin, 0.001; folic acid, 0.02; and vitamin B<sub>12</sub>, 0.0005.

Limitations of Universal Diet No. 1 are obvious. Small amounts of unknown nutrients may be present in the casein, corn oil, or cornstarch. Some of the known or suspected nutritional factors of today (such as thioctic acid, hematin, cholesterol, purines, pyrimidines, or molybdenum) were not intentionally added; such general application of this diet was not anticipated when it was formulated. Such omissions will be corrected when subsequent universal diets are made.

Preliminary experiments were intended to test one representative species in each taxonomic class of living organisms and one example from most orders of the class Mammalia. It might prove to be very interesting if other classes could be examined in more detail; however a major problem in such work is the provision of a suitable environment for the different species studied. Although no changes in composition have been made to date, the physical character of the diet was changed to suit the conditions of the experiment or the appeal of the animal being fed. Detailed results will be presented elsewhere.

*Chlorella* sp., *Escherichia coli*, *Lactobacillus arabinosis*, *Penicillium expansum*, *Saccharomyces cerevisiae*, and *Tetrahymena gellei* were maintained in pure culture through ten transfers in sterile mixtures of the diet in water. Satisfactory growth rates were obtained when the diet was fed to monkeys, pigs, cats, dogs, rats, mice, rabbits, guinea pigs, an opossum, chicks, goldfishes, cockroaches, snails, and tomato plants. The guinea pigs and snails were carried through reproduction, and four consecutive generations of mice and cockroaches were fed the diet. The success of the diet in such general application gives nutritional evidence for a fundamental unity throughout these forms of life and indicates the validity of the concept of the universal diet. The experience should be helpful in formulating another universal diet for a more critical experimental examination of the thesis.

Acceptance of the concept and the eventual use of a universal diet would be of value in many ways. Diet could be considered as a unit variable instead of as a complex variable in biological research. Interspecies comparisons of LD<sub>50</sub>, nutritional requirements, metabolic products, physiological tests, and so forth, and interlaboratory comparisons might be more valid if

a standard diet were used. The acceptance of one diet for many species could greatly simplify feeding problems for the biologist who uses a great variety of biological species and might make the work more acceptable from the viewpoint of insuring a well-fed subject. It would also facilitate the introduction of new species into the laboratory. Such a diet could be useful in a search for unknown nutritional factors; a species that fails to perform properly when fed this diet may be presumed to require an unidentified factor. This diet could appropriately be used to learn how far principles of nutrition may be applied in the complete range of biological material. Nutritional adaptations could then be better understood and eventually predicted. Nutritional similarities and differences between species, as expressed in terms of a common diet, might indicate the path of nutritional evolution and complement the work being done in

comparative biochemistry and morphology. The concept of the universal diet should give proper perspective to the place of nutrition as a common denominator of biology (4).

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17 May 1954.

## Communications

### An Instrument to Simplify Bone Drilling and Injection

There has been a need for an easier and quicker method for penetrating bone structures when intracerebral inoculations are made into animals. The present methods of trephining or cutting the skin and drilling are tedious and time consuming.

During the course of work involving a large number of monkeys, an instrument has been devised for simplifying the technique of making intracerebral injections. The instrument is shown in Fig. 1. It is a stain-

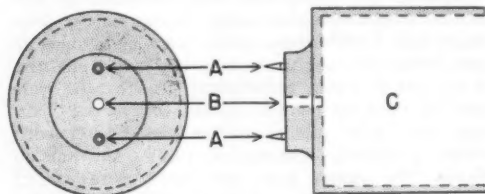


Fig. 1. Bone drilling and injection device.

less steel cup *C* with a hole *B* through the bottom and with two needle-sharp stainless-steel pins *A* attached to the bottom, one on each side of the hole. The size of the hole is determined by the size of the drill bit that is needed for penetrating the bony structure. In our laboratory we use a No. 60 bit in a portable electric dental drill. The size of the steel cup is determined by the size of the drill chuck and of the syringe. For work with monkeys, the internal dimensions of the cup *C* are  $\frac{3}{4}$  in. in diameter and  $\frac{3}{4}$  in. deep, and each pin is placed  $\frac{5}{32}$  in. from the center of the hole with the point protruding  $\frac{3}{32}$  in. from the base of the cup.

Before use, both the instrument and the drill bit are sterilized. For making intracerebral inoculations into monkeys, the hair on the head is cut as short as possible with an electric clipper. The skin is then sterilized with iodine solution followed by a 70 percent alcohol rinse, and the instrument is placed firmly against the head of the animal so that the pins penetrate the skin and rest on the skull bone, thus securing the instrument and the skin so that both are immobilized. The bit of the electric drill is then inserted through the hole of the instrument, and a hole is drilled through the skull bone. After the drill bit is removed, inoculation into the brain is made through the same hole.

This instrument has been used on approximately 500 monkeys in which two intracerebral injections of 0.5 ml each were made—one injection into each hemisphere of the brain. By using two operators, one handling the drill and the other the syringe, the time required for drilling the two holes and making the injections average about 1 min for each monkey. Occasionally, some difficulty was encountered in inserting the needle through the hole in the bone. However, a second application of the drill was adequate for obtaining free access for the needle to the soft tissue under the bone. This instrument may be adapted with only slight modification of cup size to fit any hand or electric drill. It should be extremely useful to anyone interested in bone-drilling operations where fixing the location of the drill hole is important for subsequent operation. It can be adapted for use with any species of animal.

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1 June 1954.



## Homogenization of Brain Tissue

Homogenization of cerebral tissue with Potter-Elvehjem tissue homogenizers may be incomplete because partially macerated shreds of brain adhere to the end of the rotating pestle. Complete homogenization may be obtained if a sphere 3 to 4 mm in diameter, carved out of a piece of black rubber (such as the wall of pressure tubing), is placed in the homogenizer tube containing the brain tissue, before insertion of the pestle. The rubber sphere rotates between the end of the whirling pestle and the inside of the homogenizer tube and dislodges tissue that may stick to the pestle. The rubber introduces no error, since it is insoluble and of high enough specific gravity to remain at the bottom of the aqueous suspension.

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12 July 1954.

## Properties of Clearing Factor Obtained from Rat Heart Acetone Powder

The observation by Hahn (1) that injected heparin caused rapid clearing of alimentary lipemia led to the discovery of an enzyme, clearing factor, in the serums of such animals. This "in vivo clearing factor" will also "clear" lipemic serums or coconut oil emulsions *in vitro*, and it has been the general practice to assay for the enzyme by this decrease in the turbidity of fat emulsions (2, 3).

A preliminary experiment, in collaboration with Robert S. Gordon, Jr., demonstrated that the *in vitro* clearing of a coconut oil emulsion by *in vivo* clearing factor is associated with the hydrolysis of the triglyceride to glycerol and fatty acids. In the experiments discussed here, glycerol production was followed by the procedure of Lambert and Neish (4),

modified so that 0.5 to 10  $\mu$ g of glycerol in an aliquot of 0.05 ml could be determined accurately.

It has been found that an ammonia extract of an acetone powder of normal rat heart (1 ml of 0.025N  $\text{NH}_3$  per 50 mg of powder) will catalyze the hydrolysis of chylomicrons. The rate of hydrolysis is stimulated by the addition of small amounts of heparin to the reaction vessel (Table 1, vessels 1 and 2). Further, if the acetone powder extract (APE) is preincubated with either 1M NaCl or  $10^{-3}$ M protamine for 30 min at 0°C, all of its enzymatic activity is lost. Therefore, both the basal activity and that induced by heparin behave in a manner analogous to *in vivo* clearing factor (3).

The APE, with or without added heparin, catalyzes the hydrolysis of coconut oil only very slowly, if at all. The initial rate of glycerol production from chylomicrons is at least 40 times the rate of glycerol production from coconut oil (Table 1, vessels 3 and 4). In the presence of normal serum, however, coconut oil is hydrolyzed at half the rate of chylomicrons and if the serum and coconut oil are preincubated at 38°C (but not at 0°C), the coconut oil is hydrolyzed as rapidly as the chylomicrons (Table 1, vessels 5 and 6). Serum does not stimulate the hydrolysis of chylomicrons, and taurocholate will not replace serum in the activation of coconut oil. Alcohol and ultracentrifugal fractionations of whole normal serum indicate that the activation of coconut oil is due to the alpha and beta lipoproteins only. Heparin stimulates the hydrolysis of "activated" coconut oil three- or fourfold.

In contrast to these results obtained with the rat heart APE, pancreatic lipase is neither stimulated by heparin nor inhibited by NaCl or protamine. Further, in the absence of serum, it hydrolyzes coconut oil at 5 times the rate it hydrolyzes chylomicrons.

It should be noted that, although in the experiments reported in Table 1 both albumin and  $\text{Ca}^{++}$  were used to accelerate the reaction, either may be used alone. The albumin, then, is not an obligatory component of

Table 1. Substrate specificity of clearing factor and "activation" of coconut oil.

Vessel	Substrate*	Additions at zero time†	Glycerol production ( $\mu$ M)	
			30 min	60 min
1	Chylomicrons (0.1 ml)	APE (0.1 ml)	0.11	0.26
2		APE (0.1 ml) + heparin (10 $\mu$ g, 100 units/mg)	.24	.50
3		APE (0.2 ml) + heparin (10 $\mu$ g)	.56	.92
4		APE (0.2 ml) + heparin (10 $\mu$ g)	.01	.04
5	Coconut oil (0.1 ml)	APE (0.2 ml) + heparin (10 $\mu$ g)	.20	.60
		+ normal serum (0.2 ml)	.20	.60
6	Coconut oil (0.1 ml) + normal serum (0.2 ml)‡	APE (0.2 ml) + heparin (10 $\mu$ g)	.79	1.16

\* Both the chylomicrons and coconut oil contained approximately 15  $\mu$ M of neutral fat per milliliter.

† 0.2 ml of albumin (10 percent), 0.02 ml of  $\text{CaCl}_2$  (1M) and 0.28 ml of  $\text{NH}_3\text{—NH}_4\text{Cl}$  buffer (0.25M, pH 8.5) were added to all vessels at zero time. All vessels contained a total volume of 1 ml.

‡ The coconut oil and normal serum were preincubated together for 30 min at 38°C before the other additions were made.

the system, but it can serve as a fatty acid acceptor (5) and is replaceable by other acceptors.

It would appear from the foregoing data that (i) clearing factor is primarily a tissue enzyme and is present in normal rats without the injection of heparin; (ii) clearing factor is a heparin-activated "lipoprotein lipase" that catalyzes the hydrolysis of chylomicrons but not simple triglycerides; and (iii) the incubation of coconut oil with serum makes it available as a substrate for clearing factor perhaps through the formation of a protein-triglyceride complex.

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### Exposure Duration in the Perception of Shape

Visual perception is characterized by a compromise between the physical properties of the retinal image and the tendency to recognize the color, size, and shape of objects independently of the specific retinal image pattern. This tendency is described by the terms *color*, *size*, or *shape constancy*, which emphasize the stability of perception under varying conditions of observation (1). For example, when a circular object is presented at various angles to the line of vision, subjects will match the object with ellipses that are more circular than would be predicted from the geometry of the retinal image (2). The matches tend to approach the "law of shape constancy," a theoretical condition in which perceived circularity is independent of the angle of inclination. The data represented by the circles in Fig. 1, obtained for a white disk at a 1.0-sec exposure duration, demonstrate the effect. Matches for all subjects lie above the line representing the "law of the retinal image," a theoretical condition based solely on geometric relationships, and tend by varying degrees, depending upon the subject, to approach the line representing shape constancy.

If the time the subject is allowed to view the test object is reduced to 0.01 sec, crosses of Fig. 1, the matches no longer exhibit the "constancy" effect. The data for all subjects are in good agreement with predictions made on the basis of geometric theory. Similar results were obtained using a half-dollar coin as

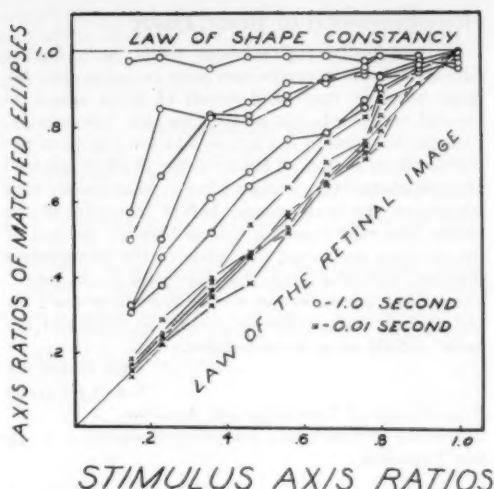


Fig. 1. Axis ratios of matched ellipses as a function of the stimulus axis ratios of a disk test object presented at various angles of inclination for two durations of exposure.

test object and, for either the coin or disk, comparing the 1.0- with a 0.1-sec exposure duration.

The absence of constancy effects and the resulting perceptions that are predictable from retinal image theory have been previously demonstrated for size and brightness judgments (3-5). In all cases, constancy was destroyed by the removal from the visual field, by means of a reduction screen or similar device, of "additional" stimuli other than the discriminative stimulus. The results of the present study (6) demonstrate that, in the case of shape discrimination, reduction of exposure time is perceptually equivalent to the removal of such "additional" stimuli which are necessary for constancy judgments.

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2. R. H. Thouless, *Brit. J. Psychol.* **21**, 339 (1931a); **22**, 1 (1931b).
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4. D. Katz, *Aufbau der Farbwelt* (J. A. Barth, Leipzig, ed. 2, 1930), p. 210.
5. C. H. Graham, in *Handbook of Experimental Psychology*, S. Stevens, Ed. (Wiley, New York, 1951), chap. 23.
6. This research was supported with funds provided by the Wisconsin State Legislature.

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## Meetings & Conferences

### October

- 3-5. Southern Psychiatric Assoc., Louisville, Ky. (G. Southerland, 2218 N. Charles St., Baltimore.)
- 3-7. Electrochemical Soc., autumn, Boston. (H. B. Linford, Columbia University, New York 27.)
- 4-6. National Electronic Cong., 10th annual, Chicago. (K. Kramer, 852 E. 83 St., Chicago 19.)
- 4-7. American Acad. of Pediatrics, Chicago, Ill. (E. H. Christopherson, 610 Church St., Evanston, Ill.)
- 4-7. International Plastics Cong., 6th, Turin, Italy. (M. Muzzoli, Salone Internazionale della Tecnica, 20 Via Massena, Turin.)
- 4-13. International Telecommunication Union, 17th, Geneva, Switzerland. (Sec., ITU, Palais Wilson, Geneva.)
- 5-7. American Inst. of Electrical Engineers, Middle Eastern District, Reading, Pa. (H. H. Henline, 33 W. 39 St., New York 18.)
- 5-8. International Cong. of Hydatid Diseases, 5th, Madrid. (J. C. Melendro, Hospital Provincial, Soria, Spain.)
- 5-14. Conf. on Weights and Measures, 10th, Sèvres, France. (Sec., Bureau International des Poids & Mesures, Pavillon de Breteuil, Sèvres.)
- 6-7. Inst. of Radio Engineers, Professional Group on Nuclear Science, 1st annual, Chicago. (T. Fields, V.A. Hospital, Hines, Ill.)
- 7-8. Central International Forest Insect and Disease Conf., 3rd annual, Wisconsin Rapids, Wis. (J. E. Kuntz, Dept. of Plant Pathology, University of Wisconsin, Madison 6.)
- 7-8. Commercial Chemical Development Assoc., annual fall, Bedford, Pa. (W. T. Hack, Ethyl Corp., 100 Park Ave., New York 17.)
- 7-9. Pan American Homeopathic Medical Cong., 25th, Rio de Janeiro, Brazil. (H. O. Skinner, 2134 Grand Ave., St. Paul 5, Minn.)
- 7-22. Pan American Sanitary Cong., Santiago, Chile. (M. E. Bustamante, Pan American Sanitary Bureau, Washington 6, D.C.)
- 8-9. Acad. of Psychosomatic Medicine, 1st annual, New York City. (E. A. Brown, 75 Bay State Rd., Boston 15.)
- 11-12. Ferrimagnetism Conf., Silver Spring, Md. (L. R. Maxwell, U.S. Naval Ordnance Laboratory, Silver Spring.)
- 11-13. American Oil Chemists' Soc., 28th annual fall, Minneapolis. (L. R. Hawkins, AOCS, 35 E. Wacker Dr., Chicago 1.)
- 11-14. Cong. of International Anesthesia Research Soc., Los Angeles. (T. H. Sheldon, 102-110 Second Ave., Rochester, Minn.)
- 11-15. American Public Health Assoc., Buffalo, N.Y. (R. M. Atwater, 1790 Broadway, New York 19.)
- 11-16. Symposium on Light Microscopy and Symposium on Electron Microscopy, Highland Park, Ill. (W. C. McCrone, Illinois Inst. of Technology, Chicago 16.)
- 13-17. Audio Engineering Soc., annual, New York City. (C. J. LeBel, AES, P.O. Box 12, Old Chelsea Station, New York 11.)
- 14-15. Bicentennial Conf. of the Columbia University College of Pharmacy, New York City. (G. W. Merck, Merck & Co., Rahway, N.J.)
- 14-16. Electron Microscope Soc. of America, Highland Park, Ill. (J. R. Cooper, ESMA, General Electric Co., Cleveland 12, Ohio.)

(See issue of 20 August for more comprehensive listings.)

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This is our way of coding "Key People in Research" on our mailing list. If you are not already on this list and would like to be kept up-to-date on Sanborn equipment for diagnosis, research and teaching, send your name and address to our inquiry director.

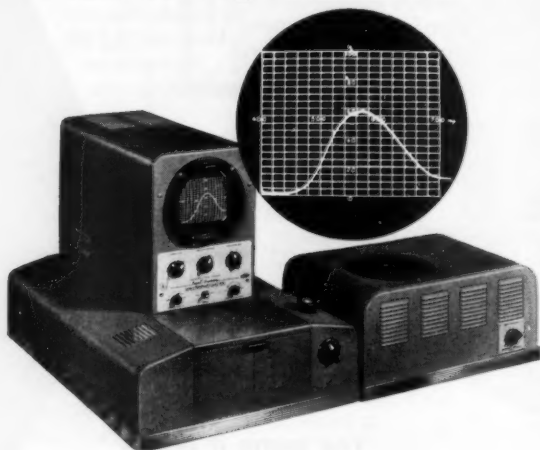
**SANBORN COMPANY**

Cambridge 39, Massachusetts



# SPECTROPHOTOMETRIC CURVES

...**60** per second



## *Rapid Scanning* SPECTROPHOTOMETER

Imagine it! *Here* is a way of following rapid color changes and transient phenomena. *Here* is a way of monitoring flowing processes. *Here* is a useful tool for rapid comparisons of transparent or opaque materials; gaseous, liquid or solid.

The AO SPECTROPHOTOMETER traces 60 separate curves per second on the face of a cathode ray tube fusing them into a "moving picture" of color changes over the entire visible spectrum from 400 to 700 millimicron wavelength.

A roomy sample chamber accommodates transparent samples up to 100mm thick. A reflection attachment will produce data from opaque surfaces as small as 1 inch square.

Permanent records can be made with any of the standard 5" oscilloscope cameras.

*Be sure to see the new AO Rapid Scanning Spectrophotometer demonstrated at your earliest convenience. For illustrated literature write Dept. 1-1.*

American Optical



INSTRUMENT DIVISION  
BUFFALO 15, NEW YORK



